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SELECTED WATER RESOURCES ABSTRACTS

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A monthly publication of the Office of Water Research and Technology,
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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

THE GEOTHERMAL HYDROLOGY OF WARNER VALLEY, OREGON: A RECONNAISSANCE STUDY,
Geological Survey, Menlo Park, CA. Water Resources Div.
E. A. Sammel, and R. W. Craig.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.00. Geological Survey Professional Paper 1044-I, 1981. 47 p, 21 Fig, 1 Plate, 9 Tab, 71 Ref.

Descriptors: *Geothermal studies, *Groundwater, *Thermal water, *Thermal properties, Aquifer characteristics, Geohydrology, Geochemistry, Warm springs, Heat flow, Thermocline, Geophysics, *Oregon, *Warner Valley.

Warner Valley, a high-desert valley situated in the Basin and Range province of south-central Oregon, contains thermal waters that are currently discharged from at least 30 springs and wells. The waters originate as local meteoric water which circulates to depths of 13,000 feet or more in faults and fault intersections in Tertiary basaltic flow rocks and tuffaceous sediments. The thermal waters are of two chemical types: sodium chloride and sodium bicarbonate waters. Temperatures in the hotter sodium chloride waters are known to be as high as 127 C; the cooler sodium bicarbonate waters are highly mixed with recharge water and have temperatures in the range 20 C to 40 C. Geothermometers and mixing models indicate that temperatures of equilibration are at least 170 C for the thermal components of the hotter waters. Conductive heat flow through the valley-fill deposits is estimated to be 75 milliwatts per square meter and the normal thermal gradient in the valley may be about 40 C per kilometer, both slightly low for the Basin and Range province. The size and location of the geothermal reservoirs are unknown. If a single reservoir underlies the two principal areas of thermal discharge, total heat stored in the reservoir above a base temperature of 10 C may be about 1.6 x 10 to the 19th power joules. If, however, the thermal fluids at depth are restricted to the major boundary faults, the stored heat at high temperatures may be about 5 x 10 to the 16th power joules. Recoverable heat at lower temperatures from depths less than 1,000 feet in the valley-fill deposits may also be about 5 x 10 to the 16th power joules. (USGS)
W82-04496

INTERPRETATION OF CHEMICAL ANALYSES OF WATER COLLECTED FROM TWO GEOTHERMAL WELLS AT COSO, CALIFORNIA,
Geological Survey, Menlo Park, CA.
R. O. Fournier, J. M. Thompson, and C. F. Austin.
Journal of Geophysical Research, Vol 85, No B5, p 2405-2410, May 10, 1980. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Geothermal studies, *Chemical analysis, *Water analysis, *Hot springs, Water temperature, Wells, Chlorides, Groundwater reservoirs, Coso, *California.

Wellhead and downhole water samples from two wells drilled for geothermal energy exploration were sampled and analyzed in an effort to predict reservoir temperatures and fluid characteristics in still unexplored parts of the system. The first well, Coso No. 1 located at Coso hot springs in California, had been drilled to a depth of 114.3 eters. The second well, CGEH No. 1 located 3.2 kilometers to the west, had been drilled to a depth of 1477 meters. The same chloride concentration is present in hot waters entering each of the wells (about 2350 milligrams per kilogram), indicating that a body of uniformly chloride-rich hot water is present at depth in the Coso geothermal system. The maximum measured temperatures were 142 C in the Coso No. 1 well and 195 C in the CGEH No. 1 well. Cation and sulfate isotope geothermometers indicate that the reservoir feeding water to the Coso hot spring has a temperature of about 240 C to 250 C, and that the reservoir feeding the CGEH well has a temperature of about 205 C. The fumarole, acid-sulfate pool, and shallow steam well expressions of hydrothermal activity in the area give a false indication of an extensive vapor-dominated system since the upward convecting, boiling, alkaline-chloride waters do not reach the surface. The presence of a chloride-rich hot water system rather than a vapor-dominated system should be considered when interpreting geophysical data and calculating the economics of exploiting the geothermal energy resource. (Carroll-FRC)
W82-04743

A MODEL OF HYDROTHERMAL CONVECTION IN AN AQUIFER,
Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY.
K. E. Torrance, V. W. C. Chan, and D. L. Turcotte.
Journal of Geophysical Research, Vol 85, No B5, p 2554-2558, May 10, 1980. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Hydrothermal studies, *Aquifers, Thermal conductivity, Turbulent flow, *Geothermal studies, Laminar flow, Transition flow, Velocity, Mathematical models, Numerical analysis.

Numerical calculations were conducted to determine the temperature distribution resulting from the steady state hydrothermal flow of water through a smoothly curved cylindrical aquifer. The outflow water temperature was found to be closest to the ambient temperature at the base of the aquifer at intermediate flow rates. Low flow velocities resulted in the cooling of the water by conduction to the wall rock before it reached the surface, while high flow velocity did not allow the water time to be heated by conduction from the wall rock. The transition from laminar to turbulent flow was found to reduce the flow through the aquifer and the temperature of the outflow water. Outflow temperatures were generally found to be too low to explain continental hot springs. Shallow laminar hydrothermal flows were shown to be more effective in transporting heat to the surface than deeper turbulent flows. These results suggest that very shallow (less than 100 meter) hydrothermal flows of seawater in the oceanic crust may be responsible for the reduction and variability of the measured near-surface geothermal gradient. (Carroll-FRC)
W82-04744

1B. Aqueous Solutions and Suspensions

THE CHEMISTRY OF SALINE WATER CHLORINATION,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 3C.
W82-04729

2. WATER CYCLE

2A. General

RELATION BETWEEN CURVE NUMBER AND RUNOFF COEFFICIENT,
Maryland Univ., College Park. Coll. of Engineering.
R. H. McCuen, and T. R. Bondelid.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 395-400 December, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Watersheds, *Graphical methods, *Land use, *Computer models, Model studies, Graphical analysis, Mathematical studies, Mathematical models, *Runoff, Peak discharge, Hydrologic models.

Two peak discharge methods, the rational formula and the TR-55 graphic method, are based on similar input data and give similar peak discharge estimates when land use is similar. Peak discharge estimates by the rational formula are more sensitive to runoff coefficient (C) values than are TR-55 estimates to the runoff curve number (CN). The graphical method is based on the conceptual framework of the RUNOFF subroutine of the Soil conservation Service (SCS) TR-20 computer program, which should form peak discharges similar to those obtained with the rational formula. Disparities in land use values create C values that are higher than normally acceptable. This bias should be taken into account when design projects are controlled by different policies. For residential and open space land use categories, the graphical method generally provides higher peak discharge estimates than the rational method. The SCS methods, including the TR-55 graphical method, ae based on a 24 hr storm distribution and do not necessarily have to include a bias in estimating the peak discharge. (Geiger-FRC)
W82-04266

YOUNG'S INEQUALITY FOR THREE-DIMENSIONAL FLOWS,
Public Power Corp., Athens (Greece). Computing Center.
A. T. Marinos.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 388-394, December, 1981. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Mathematical equations, *Drainage, *Precipitation intensity, *Flow profiles, Mathematical models, Darcys law, Youngs modulus, Water table, *Porosity.

Young's inequality for steady drainage through a porous strip contained between two parallel ditches is useful for relating the height of the water table at its center, the precipitation intensity, the ditch spacing, and the level of permanent water horizon. An extension of Young's inequality to three-dimensional flow is presented which may be applied to calculate the limits on precipitation intensity for steady flows so that the maximum height of the water will not exceed a prescribed value. The equations for calculating these bounds take on closed type formulas when the steady drainage takes place through regular (rectangular) cross sections and the precipitation intensity is such that a formal solution of the partial differential equation is possible. (Geiger-FRC)
W82-04267

PROBLEMS OF MODELLING A HIGH MOUNTAINOUS DRAINAGE BASIN WITH PREDOMINANT SNOW YIELDS,
Grenoble-1 Univ. (France). Inst. de Mecanique.
R. Charbonneau, J.-P. Lardeau, and C. Obled.
Hydrological Sciences Bulletin, Vol 26, No 4, p 345-361, December, 1981. 11 Fig, 4 Tab, 14 Ref.

Descriptors: *Hydrologic models, *Snowmelt, *Hydrologic cycle, *Catchment areas, Model studies, Evapotranspiration, Evaporation, Energy, Air temperature, Physiographic balance, Drainage area, Precipitation, Snow, Mountains, *Durance River basin, *French Alps.

Three snowmelt and evapotranspiration models for a high mountain drainage basin of the Durance River in the French Alps were developed and compared. The Durance model was specifically designed for the basin and used a refined description of the physiographic features and snowmelt routine based on energy budgets at 12 hr intervals. The HSP general purpose hydrological model was partially standardized and showed the best four-year adjustment due to its large number of degrees of freedom. An intermediate model kept all the parameter values of the HSP model, but did not benefit from a heat budget component. This modified HSP model receives air temperature values from a main program which has been shown to systematically underestimate the maximum temperature which influences snowmelt. The ready-made models took almost as long to set up and adjust as the Durance model. Major errors in calculations did not occur in the modelling of the hydrological cycle but rather in peripheral parameters dealing with data estimation or extrapolation.

It was suggested that standardized procedures for the estimation of missing model data be avoided and replaced by objective analyses of precipitation, snow cover and temperature fields of the drainage basin. (Geiger-(FRC)
W82-04303

RELATIVE RUNOFF BY CURVE NUMBER NOMOGRAPH,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 385-388, December, 1981. 1 Fig, 10 Ref.

Descriptors: *Graphical methods, *Watersheds, *Mathematical models, *Storm runoff, *Discharge measurement, Graphical analysis, Runoff, Model studies, Runoff, Precipitation, Mathematical equations, Mathematical studies, *Channel morphology.

The graphical solution for relative discharge allows rapid estimation of runoff changes due to watershed modifications and visual evaluation of the sensitivity of runoff change to the Soil Conservation Service curve number (CN) modifications and storm precipitation. An equation for relative runoff may be used for a more accurate calculation; however, an analysis based on curve numbers should be regarded as only an approximate solution. The relative runoff equation may be solved by graphical methods. Vertical and horizontal nomographs are used to intersect two specific sections of the rectangular chart, and the curve corresponding to the Cartesian coordinate defined by these two intersections represents the relative runoff. Graphical analysis of relative change provides a pragmatic basis for anticipating runoff modification for problems where actual discharge can be measured or estimated by alternative methods. (Geiger-FRC)
W82-04307

DIMENSIONLESS STREAM ADVANCE IN SLOPING BORDERS,
Science and Education Administration, Phoenix, AZ. Conservation Lab.
For primary bibliographic entry see Field 3F.
W82-04308

THE GENERAL HYDROLOGIC SYSTEM MODEL,
Mississippi State Univ., Mississippi State. Dept. of Mathematics.
R. C. McCann, and V. P. Singh.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, 1581-1592, December, 1981. 3 Fig, 14 Ref.

Descriptors: *Hydrographs, *Storm runoff, *Hydrologic models, General Hydrologic System model, Model studies, Runoff, Rainfall-runoff relationships, Excess rainfall, Chow and Kulandaiswamy model.

Improvements and simplifications are suggested for Chow and Kulandaiswamy's General Hydrologic System model. The problem of negative instantaneous unit hydrographs, arising from the inconsistencies in the derivations and initial conditions, was solved by assuming an instant unit hydrograph of zero at zero time. This caused coefficients associated with derivatives of excess rainfall to vanish. (Cassar-FRC)
W82-04314

TWO-DIMENSIONAL SOIL MOISTURE FLOW IN A SLOPING RECTANGULAR REGION: EXPERIMENTAL AND NUMERICAL STUDIES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
J. L. Nieber, and M. F. Walter.
Water Resources Research, Vol 17, No 6, p 1722-1730, December, 1981. 12 Fig, 23 Ref.

Descriptors: *Soil water, *Slopes, *Infiltration, Numerical analysis, Hydrographs, Flumes, Rainfall infiltration, Capillarity.

The two-dimensional flow of soil moisture under the conditions of rainfall infiltration was studied in a hillslope soil moisture flow laboratory model composed of a flume (3.66 x 0.58 x 0.108 m) filled with sand. Experimental results, expressed as hydraulic head fields and runoff hydrographs, agreed well with results from a numerical solution after the effects of capillary hysteresis were incorporated into the numerical solution. Without considering the capillary hysteresis the numerically simulated hydrograph lagged behind the experimental hydrograph to a significant degree. the numerical technique was derived from a finite element-finite difference solution of the Richards equation. (Cassar-FRC)
W82-04333

STORM RUNOFF ANALYSES ON THREE SEMI-ARID CATCHMENTS,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
D. L. Murray, and A. H. M. Gorgens.
Water SA, Vol 7, No 4, p 223-233, October, 1981. 6 Fig, 6 Tab, 16 Ref.

Descriptors: *Storm runoff, *Rainstorms, *Hydrographs, *Semiarid lands, Rainfall-runoff relationships, Statistical analysis, Ecca River, Grahamstown, *South Africa, Runoff, Rainfall intensity, Evaporation, Streamflow, Antecedent moisture, Peak flow.

A statistical analysis of storm rainfall and streamflow data (1975-1979) from 3 semiarid catchments in the Ecca River region, South Africa, produced preliminary equations for predicting storm hydrograph characteristics. The best index of catchment wetness at the beginning of a storm was generally the seven-day antecedent rainfall. Storm flow volume was predicted using seven-day antecedent rainfall and storm rainfall. Storm flow peak and storm flow duration were obtained from predicted storm flow volume. Independent variables considered in this study were storm rainfall, rainfall duration, maximum intensity of rainfall, antecedent flow, and antecedent rainfall and moisture indices calculated by accumulating rainfall and potential evaporation over varying periods prior to storms. (Cassar-FRC)
W82-04339

HYDROGEOLOGIC EVALUATION OF WETLAND BASINS FOR LAND USE PLANNING,
Lowell Univ., MA. Dept. of Earth Sciences.
A. L. O'Brien, and W. S. Motts.
Water Resources Bulletin, Vol 16, No 5, p 785-789, October, 1980. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Wetlands, *Classification, *Land use, *Groundwater potential, Geohydrology, Geology, Topography, Geomorphology, Water quality, Aquifers, Hydrology.

Since wetlands vary according to geologic, hydrologic and topographic settings, a wetland classification based on these factors which modify hydrologic response is proposed to provide a good framework for evaluation of wetland research in relation to land use planning. Wetlands affect the potential for groundwater development in wetland dominated basin, modify the character of runoff from a basin and influence the discharge/recharge relationship with the underlying aquifer. Some geologic and hydrologic factors which might allow distinction between wetlands include the character and thinkness of surficial materials, bedrock type, hydrologic position, permeability of the organic layer, transmissivity, water quality, aquifer structure, groundwater outflows and depth of standing water. Some distinguishing topographic features of wetlands are position in the drainage basin, relative size, and absolute size of wetlands. Application of the proposed classification scheme to wetlands in the northeastern United States produced two realistic geologic types that could be expected to be encountered. Matrices of these two types produced 25 categories of wetlands, 13 of which are common types. These types should be further tested to define their hydrologic function in this classification scheme. (Geiger-FRC)
W82-04439

ANALYSIS OF DETENTION BASIN SYSTEMS,
Monash Univ., Clayton (Australia).
R. G. Mein.
Water Resources Bulletin, Vol 16, No 5, p 824-829, October, 1980. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Mathematical models, *Detention reservoirs, *Design criteria, *Flood peak, *Flood-control storage, Hydrologic models, Model studies, Catchment basins, Flood hydrographs, Storm runoff, Flood routing, Simulation analysis, Mathematical studies.

Simple procedures of designing detention basins to reduce peak flows on rivers and streams are often limited in scope. A more complicated routing model is described, and its application to an urban basin system at Gardiners Creek, Australia is examined. The model computes design inflow hydrographs and routes flow downstream to the next point of interest. The catchment is divided into subcatchments along watershed lines, excess rainfall is calculated from the temporal pattern of the nearest recording rain gauge, and the depth is obtained from the isohyetal map of the storm event. Catchment storage effects are simulated by routing flows between subcatchments through simple nonlinear storage elements. The present model was found suitable for examining basins in series or in parallel. Although it seems unlikely that the addition of a basin would increase flood peaks downstream to any significant extent, it still may be possible for a particular combination of basins to have this effect. It is therefore suggested that multibasin systems be fully investigated under various storm events to assess the individual contribution of each basin to flood mitigation. (Geiger-FRC)
W82-04444

COMPARISON OF MODELS FOR FORECASTING SNOWMELT RUNOFF VOLUMES,
Maryland Univ., College Park. Dept. of Civil Engineering.
M. E. Hawley, R. H. McCuen, and A. Rango.
Water Resources Bulletin, Vol 16, No 5, p 914-920, October, 1980. 4 Tab, 8 Ref.

Descriptors: *Snowmelt, *Runoff-forecasting, *Model studies, Mathematical studies, Water supply, Remote sensing, Hydrologic models, Comparison studies.

Available snowmelt models were tested for accuracy on a single watershed using the same data base. Specific analyses were made for determining the value of Landsat derived snow covered area (SCA) data in the various runoff prediction models; to investigate the value of subdividing the watershed into smaller, more homogeneous areas; to determine the effect of delays in data collection such as that which might occur in the compilation and analysis of Landsat data; to evaluate the accuracy of forecasts based solely on SCA measurements; and to determine the length of record required for model calibration. Models tested include the Regression model, the Water Balance model, and the Martinec model. Accuracy of the Tangborn model and the regression models was greater if the test data fell within the range of calibration data rather than outside. Regression models were significantly more accurate for forecasts of 60 days or more than for shorter periods. The Tangborn model was more accurate for forecasts of 90 days or more. The Martinec model was more accurate for forecasts of 1, 2, 3, 5, 10, or 15 days. Accuracy of long term models was independent of forecast data. The short term models were least accurate for forecast periods in late May and early June. The Martinec model was the best of those tested for one and two day forecasts. Regression models were roughly equal in accuracy. Spatial separation of the watershed by elevation zones did not improve the accuracy of the Martinec model in the Kings River basin. Delays in data collection of more than one day may sig-

nificantly lessen the accuracy of the Martinec model. (Baker-FRC)
W82-04452

PREDICTION OF WATER INFLOW TO LAKE MEMPHREMAGOG (PREVISION DES APPORTS HYDRIQUES AU LAC MEMPHREMAGOG),
Ministere de l'Environnement, Sainte-Foy (Quebec). Service des Eaux de Surface.
V. D. Hoang, and B. Robert.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 433-441, 1981. 4 Fig, 3 Tab, 5 Ref. English summary.

Descriptors: *Hydrologic models, *Lakes, *Forecasting, Prediction, Water levels, *Lake Memphremagog, *Quebec, Flood control, Snowmelt, Runoff, Watersheds, *Inflow forecasting.

Water inflow forecasts are being designed for some Quebec watersheds for the purposes of environmental protection and to fulfill international agreements. Accurate assessment of runoff during the spring thaw and periods of heavy rain was necessary for Lake Memphremagog near Magog, Quebec, in view of the low discharge capacity at the outlet of the lake and the obligation to regulate water levels. A hydrometeorologic model of the deterministic type, the SSARR (streamflow synthesis and reservoir regulation) model, was selected. This model makes it possible to calculate the snowmelt based on daily temperature and precipitation values, whereas the other possibility, the Ohio-Stanford model, requires a knowledge of numerous physical parameters requiring complex measurements. The SSARR model incorporates sub-models of the watershed, the river drainage, and the lake reservoir, plus a forecasting model. The resulting model was calibrated using data from the Black River for 1971-1973, then verified with data from 1974 and 1975. The error in the observed flow compared to the calculated flow was estimated using the criterion of volume, the point criterion, and the final criterion. Predictive application of this model in 1979 gave highly encouraging results, with an error of about 16%. Further improvements are desired to reduce the error to 10%, but the information already available will permit adequate flood warning for downstream residents plus systematic operation of the outlet dam. (Carroll-FRC)
W82-04459

REGIONAL HYDROLOGIC MODELS FOR CLIMATOLOGY: AN APPLICATION TO THREE WISCONSIN WATERSHEDS,
Wisconsin Univ.-Madison.
D. R. Clark.
PhD Thesis, May, 1981. 106 p, 19 Fig, 17 Tab, 35 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-17508.

Descriptors: *Watersheds, *Hydrologic models, *Seasonal variation, *Evapotranspiration, Runoff, Drainage, Recharge, Soil moisture retention, *Climatology, *Wisconsin.

Two hydrologic models are applied to three watersheds in south central Wisconsin over a thirty year period. Although in the same climatic region, the three watersheds have different hydrologic responses due to their different basin characteristics. The two models are designed for the study of seasonal interactions between external climatic factors and regional hydrologic responses. Input data consists of monthly rainfall, snowmelt, absorbed solar radiation, frost depth and an empirical vegetation seasonality index. Evapotranspiration is parameterized in terms of absorbed solar radiation, a vegetation seasonality index, and moisture storage. Parameterization of runoff and drainage between storages includes the effect of soil freeze and moisture storage. Model parameter values were obtained by calibration of model runoff to observed streamflow. Model storage levels were compared to water table observations in one watershed. Sensitivity of the calibrations was tested by a series of Monte-Carlo experiments using randomly perturbed input data, and by parameter sensitivity tests. The two storage model is found to simulate streamflow just as well as the three-storage model. Normal spring ground water recharge is reduced or absent when preceding fall precipitation fails to replenish summer soil moisture losses, or scant snowcover permits deep winter soil freeze. Major recharge episodes result from consecutive months of excessive precipitation or snowmelt, but not from an isolated high-input month. (Sinha-OEIS)
W82-04483

DIGITAL-MODEL SIMULATION OF THE TOPPENISH ALLUVIAL AQUIFER, YAKIMA INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
E. L. Bolke, and J. A. Skrivan.
Geological Survey Open-File Report 81-425 (WRI), 1981. 34 p, 14 Fig, 2 Tab, 8 Ref.

Descriptors: *Computer models, *Aquifers, *Surface-groundwater relations, *Water use, Simulation analysis, Model studies, Water demand, Hydrologic budget, Irrigation, Streamflow, Wells, Water levels fluctuations, Groundwater movement, Hydraulic conductivity, *Washington, *Yakima Indian Reservation, Yakima River.

Increasing demands for irrigating additional lands and proposals to divert water from the Yakima River by water users downstream from the Yakima Indian Reservation have made an accounting of water availability important for present-day water management in the Toppenish Creek basin. A digital model was constructed and calibrated for the Toppenish alluvial aquifer to help fulfill this need. The average difference between observed and model-calculated aquifer heads was about 4 feet. Results of model analysis show that the net gain from the Yakima River to the aquifer is 90 cubic feet per second, and the net loss from the aquifer to Toppenish Creek is 137 cubic feet per second. Water-level declines of about 5 feet were calculated for an area near Toppenish in response to a hypothetical tenfold increase in 1974 pumping rates. (USGS)
W82-04514

EVALUATION OF METHODS FOR DETERMINING URBAN RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 4C.
W82-04535

A KINETIC MODEL FOR SURFACE MINE SEDIMENT YIELD,
Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W82-04552

SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-04646

A DIMENSIONLESS UNIT HYDROGRAPH FOR URBANIZING CATCHMENT AREAS,
Sir William Halcrow and Partners, London (England).
M. J. Hall.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 37-50, March, 1981. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Urbanization, *Hydrographs, *Streamflow forecasting, Land use, Rainfall-runoff relationships, Paving, Runoff, *Urban runoff, Excess rainfall, England.

A method for quantifying changes in flow regimes caused by urbanization was developed. Unit hydrographs corresponding to a common duration for catchments in different stages of urban growth were correlated with catchment characteristics such as degree of urban development. This procedure was used with data from several areas in England to derive a dimensionless one-hour unit hydrograph. The scaling parameter for the hydrograph was expressed as a function of the basin ratio and the percentage of impervious area. (Cassar-FRC)
W82-04683

FORECASTING CHANGES OF WATER RESOURCES IN LARGE RIVERS FOLLOWING LAND DRAINAGE,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
S. M. Novkov, and J. S. Goncharova.
Hydrological Sciences Bulletin, Vol 26, No 4, p 393-398, December, 1981. 10 Ref.

Descriptors: *Hydrologic budgets, Evaporation, Swamps, *River basins, *Drainage effects, *Hydrologic models, *Land management, Groundwater depletion, Predictions, Marshes, Wetlands, Catchment areas, Runoff, Model studies, Simulation analysis, Mathematical studies, Drainage.

Methods for predicting the annual water balance of a large river basin after drainage are considered. The precipitation of the model situations was assumed to be constant and unaffected by drainage. Drainage in the improved basins caused the annual runoff to decrease groundwater and swamp water resources, leading to changes in evaporation patterns. Reductions in groundwater resources were calculated for each percent of the basin drained, based on experimental data on the hydrophysical properties of mineral soils and subsoils and peats. Using this method, reductions in groundwater were taken into account, while changes in runoff were predicted. Evaporation changes were calculated from the difference between the potential evaporation (maximum possible evaporation) from cultivated sections and that from undisturbed swamps. (Geiger-FRC)
W82-04721

2B. Precipitation

A PRELIMINARY STUDY OF COMPARATIVE MEASUREMENTS OF RAINFALL RATE USING THE DIFFERENTIAL REFLECTIVITY RADAR TECHNIQUE AND A RAINGAGE NETWORK,
Ohio State Univ. Columbus. Dept. of Electrical Engineering.
T. A. Seliga, V. N. Bringi, and H. H. Al-Khatib.
Journal of Applied Meteorology, Volume 20, No 11, p 1362-1368, November, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Remote sensing, *Radar, *Rainfall, Raingages, Rainfall distribution, *Rainfall rate, Mathematical studies, Rainstorms, Chicago, Illinois, Measuring instruments, Calibrations, Spatial distribution.

Areal measurements of rainfall rate obtained by the differential reflectivity Z-DR technique were compared with raingage measurements and conventional radar measurements for two 550 sq km areas in the Chicago region over time intervals of about 1 hr. Z-DR is defined as ten times the logarithm of the quotient of the reflectivity at horizontal polarization divided by the reflectivity at vertical polarization. A relativecalibration between horizontally and vertically polarized reflectivities was done by pointing the radar vertically and comparing reflectivity factors at orthogonal polarizations. On the test day rainfall occurred over a wide area and lasted for several hours. Excellent agreement between radar Z-DR and raingage measurements was found; the Z-DR results were considerably better than those from two Z-R (reflectivity-rainfall rate) relationships, one of which was calibrated with 20 minutes of gage measurements. The University of Chicago-Illinois State Water Survey radar used had slow polarization switching, and significant improvements in the differential reflectivity measurements would be obtained by pulse-to-pulse switching of polarization. Over one of the 550 sq km areas the Z-DR method measured 86%

of the rainfall recorded on 26 raingages during an observation period of 80 min, and over the other, 117% of the rainfall recorded on 27 raingages was obtained during a 40 min period. (Carroll-FRC)
W82-04263

DIFFERENCES BETWEEN SOME RADAR RAINFALL ESTIMATION PROCEDURES IN A HIGH RAIN RATE GRADIENT STORM,
Bureau of Reclamation, Denver, CO.
G. E. Klazura.
Journal of Applied Metorology, Vol 20, No 11, p 1376-1380, November, 1981. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Remote sensing, *Rainfall, *Rain gages, *Radar, Rainfall distribution, Rainfall intensity, Mathematical studies, Convective precipitation, Rainstorms, Montana, Calibrations, Spatial distributions.

Attempts have been made to achieve optimal estimates of precipitation by combining radar and raingage data, essentially using raingages to calibrate the radar measurements. One method of calibration is that of computing an adjusted radar-rainfall field by means of the G/R ratio (gage amount divided by the sum of radar-derived rainfall throughout a rainfall event). A study was conducted to examine how much the G/R ratios would vary in an actual high rainfall-rate gradient situation considering the location and size of the radar contributing area, computation of radar-estimated rainfall using maximum, average or integrated values, and radar reflectivity factor threshold for average and integrated values. Data examined were collected on a convective shower day, June 6, 1976 at Miles city, Montana. Differences exceeded a factor of 6 and 3 were observed for individual gages and for the mean of 17 gages, respectively. Conclusions were incompleted because of the limited data set analyzed and the absence of positive truth, i.e., knowledge of the location of the most representative radar bin. Withouth a comparative analysis it was impossible to know whether improvements in G/R values will produce better rainfall estimates. If wind information is available at each gage location it may be possible to make a reverse trajectory analysis to identify the most representative radar bin for each averaging time period. If isolation of the representative radar bin is not possible, it is probably best to use either the averaging or integrating method with a reflectivity factor threshold, allowing for precipitation drift and evaporation. (Carroll-FRC)
W82-04265

HYDROCLIMATOLOGICAL CHARACTERISTICS OF ISOLATED SEVERE RAINSTORMS,
Illinois State Water Survey, Urbana.
S. A. Changnon Jr., and J. L. Vogel.
Water Resources Research, Vol 17, No 6, p 1694-1700, December, 1981. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Rainfall intensity, *Weather forecasting, *Storms, Precipitation intensity, Flood forecasting, Flash floods, Local precipitation, *Illinois, Rainstorms, Rainfall distribution, Rain gages, Climatology.

Intense, very localized severe rainstorms were studied in Illinois, where four dense rain gage networks produced data from 32 storms in the warm season, May-September, 1955-1978. These storms, responsible for flash floods with resulting erosion and water pollution, generally last 3-12 hours, affect less than 1000 sq km, and have 1 to 4 hour rainfall totals in excess of 7.5 cm. About 40 such storms occur over Illinois (145,000 sq km) each warm season. The storm of July 30-31, 1979, over central Illinois is described in detail. The storm began at 1445 CDT and ended by 2100. Over 17.8 cm of rain fell, with the greatest intensity within 4 hours, at a station near Urbana. The core of this storm was extremely small. Only 8 sq km received a depth of 18 cm or more, and 960 sq km received 5 cm or more. The storm occurred in a maritime tropical air mass and was not associated with frontal activity. Prior to the start of the storm the surface dewpoint temperature was greater than normal (23-26 C), the atmosphere was unstable, precipitable water from the surface to 400 mb was greater than average (3.97 cm), and wind speeds increased with height from 7.7 mps at 850 mb to 12.9 mps at 500 mb. Three distinct precipitation systems with a total of nine rain cells moved over the region. Radar and satellite photos can be used to detect the development of localized intense rainstorms. Characteristics of this type of storms--stationary multicelled in nature with strong preference for afternoon development--are keys for detection and local flood warnings. (Cassar-FRC)
W82-04336

SECULAR CHANGES IN ANNUAL AND SEASONAL GREAT LAKES PRECIPITATION, 1854-1979, AND THEIR IMPLICATIONS FOR GREAT LAKES WATER RESOURCE STUDIES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab. MI.
F. H. Quinn.
Water Resources Research, Vol 17, No 6, p 1619-1624, December, 1981. 5 Fig, 5 Tab, 12 Ref.

Descriptors: *Water level fluctuations, *Seasonal variation, *Water management, *Great Lakes, *Precipitation, Climatic data, Lakes, Lake shores, Erosion, Statistical analysis.

Two distinct precipitation regimes were identified by statistical analysis of annual precipitation data in the Great Lakes basin from 1854-1979. Since the late 1930's the precipitation regime has been relatively wet, with an increase in average annual precipitation of 50 mm per year, due primarily to greater amounts of spring and summer precipitation. A dry period existed from the mid- 1880's to about 1940. Prior to 1880 the sketchy records indicate that precipitation was similar to the present. Recorded levels of Michigan-Huron-Erie corresponded with the precipitation through the years of interest. In addition, annual flows of the Niagara River from 1860 to the present show above average flows before 1890 and after 1940, with below average flows in the interim years. This may mean that the present relatively wet conditions are the normal climate for the basin. If this persists, water managers must deal with problems such as poor performance of the current Great Lakes regulation plans, continuing erosion due to high lake levels, and revisions in water supply forecasting techniques to account for higher precipitation. (Cassar-FRC)
W82-04431

COMPARISON OF MODELS FOR FORECASTING SNOWMELT RUNOFF VOLUMES,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-04452

THUNDERSTORM IN AGRICULTURE AND IN FOREST MANAGEMENT,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
D. G. DeCoursey, W. L. Chameides, J. McQuigg, M. H. Frere, and A. D. Nicks.
In: Thunderstorms: A Social, Scientific, and Technological Documentary, Vol I, The Thunderstorm in Human Affairs, NOAA, September, 1981, p 85-112, 21 Fig, 1 Tab, 54 Ref.

Descriptors: *Thunerstorms, *Forest management, *Agriculture, Precipitation, *Water pollution, Nitrogen fixation, Lightning, Flooding, Soil erosion, Water pollution, Sediments, Hail, Nutrients, Pesticides, Channel erosion, Gully erosion, *Storm runoff, Sediment transport, Overland flow.

Precipitation can be divided into two general types: that associated with weak ascending air currents on a scale of about 1,000 km, and that associated with rapid overturning of a local air mass with large variability of air motion and precipitation on a scale of tens of kilometers. The showers and thunderstorms identified with the second type can be beneficial or harmful to agriculture. Beneficial effects of thunderstorms include: moisture for crop production; farm and ranch water supply; irrigation water supply; and nitrogen fixation by lightning. Harmful effects of thunderstorms can be grouped into four major areas: damage directly to rangeland and crops by hail, flooding, or wetting an air-dried product; erosion of cropland caused by excessive runoff rates; leaching of plant nutrients from the soil profile; polluting surface waters; flooding of cropland along major streams. Heavy rain, usually associated with thunder, produces large volumes of surface runoff, with resulting loss of soil and associated pollutants, including sediment, nutrients, and pesticides. Overbank flooding on a typical stream is estimated to occur once in 1 to 4 years. Quite often, flooded areas include the most productive soils planted with high-yield crops. Erosion of stream channels and gullies indirectly resulting from heavy rains is a major problem. (Moore-SRC)
W82-04617

REMOTE SENSING OF ATMOSPHERIC WATER CONTENT FROM SATELLITE MICROWAVE RADIOMETER (SAMIR) ON BHASKARA,
Indian Space Research Organization, Ahmedabad. Space Applications Centre.
For primary bibliographic entry see Field 7B.
W82-04647

CHEMICAL COMPOSITION OF MONSOON RAINWATER OVER BHOPAL, MADHYA PRADESH (INDIA) DURING 1977 AND 1978,
Indo-British Betwa Groundwater Project, Bhopal (India).
D. K. Das, G. K. Burman, and A. L. Kidwai.
Mausam, Vol 32, No 3, p 221-228, July, 1981. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Rain, *Chemical composition, *Monsoons, *India, Bicarbonates, Calcium, Salinity.

Monsoon rainwater samples collected at Bhopal, India, during June-August 1977 and April-September 1978 contained variable levels of chemical constituents. Bicarbonate and calcium were the predominant anion and cation, with concentration ranges of 2.4-32.0 (average 10.0) mg per liter and 0.6-12.0 (average 3.0) mg per liter, respectively. pH ranged from 6.0 to 7.2, average 6.2. EC varied from 15 to 80 micromhos per cm at 25 C. Concentration ranges of other constituents were as follows (in mg per liter): chloride, 0.9-9.4 (average 3.4); sulfate, 1.2-5.8 (average 3.2); nitrate, 0.12-0.88 (average 0.5); Mg, 0.16-4.3 (average 0.81); Na, 0.08-4.3 (average, 0.80); K, 0.01-1.2 (average 0.16); boron, 0.002-0.068; fluoride, 0.1; Fe, 0.01-0.08; and silica, 0.4-2.8. Ranges of trace metals were as follows (in ppb): Sr, 1-30; Zn, 10-76; Mn, 1-5; Cu, 1-8. No Li or Ni was detected. It is believed that most of the chemical constituents in the monsoon rainwater were from non-marine sources. (Cassar-FRC)
W82-04666

USEFULNESS OF MONTHLY RAINFALL NORMALS IN AGROCLIMATIC MAPPING,
Meteorological Office, Poona (India).
R. R. Kelkar.
Mausam, Vol 32, No 2, p 181-188, April, 1981. 7 Fig, 16 Ref.

Descriptors: *Rainfall distribution, *Mapping, *Planting management, Agriculture, *India, Crops, Planning, Seasonal variation, Meteorological data collection.

Several attempts to obtain rainfall data more appropriate than monthly rainfall data for agricultural planning in India are described. Most data and maps apply to the state of Maharashtra. The sowing rains concept is based on the dates of commencement of sowing rains (CSR), which are defined as a spell of at least 25 mm of rain in 7 days with 1 mm or more on any 5 of these 7 days. Raman applied this method to maps showing CSR dates for Maharashtra. Also indicated are standard deviation of CSR, average interval between CSR and next wet spell, and median CSR distribution. This information shows areas where likelihood of short growing seasons and necessity of second

sowings are high. Probability analysis indicates the probability of rainfall being adequate in a given week. India's total annual rainfall does not vary widely in spite of droughts and floods. Therefore the coefficient of variation has been used to indicate monthly rainfall patterns in stations throughout India. A simple method, an extension of the National Commission on Agriculture's mapping technique, involves only monthly normals of rainfall and number of rainy days. This accounts for large amounts of rainfall on isolated occasions when much water is lost as runoff. Maps prepared using this technique indicate optimum time of sowings, good locations for surface runoff ponds, places for early-maturing varieties, and sites for no karif planting but early rabi planting. (Cassar-FRC)
W82-04668

A PHYSICAL REASON FOR HIGHER PH OF TROPICAL RAINWATER,
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 2K.
W82-04669

STATISTICAL FORECASTING OF HEAVY RAIN AND FLOODS IN THE RIVER TEESTA,
Flood Meteorological Office (India).
A. Lahiri.
Mausam, Vol 32, No 1, p 41-44, January, 1981. 2 Fig, 7 Tab, 8 Ref.

Descriptors: *Rainfall distribution, *Synoptic analysis, *Flood forecasting, Weather forecasting, Forecasting, *Teesta River, *India, Monsoons, Rainfall-runoff relationships, Mountains, Precipitation.

Heavy rain producing synoptic systems were associated with intervals of average precipitation to produce quantitative precipitation forecasting in the 80% mountainous Teesta River catchment, India. The region is affected by six categories of heavy rain producing synoptic systems, classified according to the position of the low pressure areas or monsoons. The frequency distributions of floods occurring from precipitation amounts of 11-25, 26-50, and > 51 mm in the six categories range from 2 to 19, with a total of 46. Frequency distributions of heavy average areal precipitation for the same groups of precipitation amounts in the 5 months of the flood season are as follows: June, 113, July, 122, August, 105, September, 70, and October, 13. June, July, and August are the most flood prone months, partly because heavy rains are not evenly distributed. In September and October heavy rains are more evenly distributed. (Cassar-FRC)
W82-04670

EVIDENCE OF URBAN AND LAKE INFLUENCES ON PRECIPITATION IN THE CHICAGO AREA,
State Water Survey Div., Champaign.
S. A. Changnon, Jr.
Journal of Applied Meteorology, Vol 19, No 10, p 1137-1159, October, 1980. 17 Fig, 11 Tab, 20 Ref.

Descriptors: *Precipitation, *Urban areas, *Lakes, *Rainfall, Areal precipitation, *Environmental effects, Convective precipitation, Rainfall distribution, Storms, Illinois, *Chicago, St Louis, Missouri.

A study of summer precipitation conditions in the Chicago, Illinois, area sought to discern evidence of urban influences on precipitation processes and on rainfall magnitude by investigating the time and space characteristics of clouds, radar echoes, surface rainfall, and thunderstorms. Historical data for the period 1931 through 1977 anddata from new and special instruments operated during the period 1975 through 1978 were investigated to identify local and regional influences as suggested by precipitation time trends, the areal distribution of heavier rainstorms, thunderstorm frequencies, cloud distributions, radar echo characteristics, raincells, rainfall in discrete rain periods, and total rainfall. An area of 15 percent greater rainfall, which was considered largely a result of urban influences, was identified in central Chicago. Although the degree of change is less than that found in studies at St. Louis, possibly as a result of the inhibiting effects of the lake at Chicago, there was general agreement between these two studies with respect to the placement of the rain change, the synoptic weather conditions when rain changes occur, and the tendency for rain changes to exist in heavier rainfall conditions. Limited causative studies suggest an urban enhancement of convective clouds over Chicago and southern Lake Michigan during the later afternoon. Case studies of radar echo behavior showed that maximum echo intensification repeatedly occurred over the city and at higher elevations than in non-urban cells. (Carroll-FRC)
W82-04741

2C. Snow, Ice, and Frost

PROBLEMS OF MODELLING A HIGH MOUNTAINOUS DRAINAGE BASIN WITH PREDOMINANT SNOW YIELDS,
Grenoble-1 Univ. (France). Inst. de Mecanique.
For primary bibliographic entry see Field 2A.
W82-04303

ELEVATION: A MAJOR INFLUENCE ON THE HYDROLOGY OF NEW HAMPSHIRE AND VERMONT, USA,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
For primary bibliographic entry see Field 2E.
W82-04304

A NEW METHOD FOR SAMPLING SNOW MELT AND RAINFALL IN FORESTS,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
For primary bibliographic entry see Field 7B.
W82-04435

TESTS OF FRAZIL COLLECTOR LINES TO ASSIST ICE COVER FORMATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
R. E. Perham.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 442-448, December, 1981. 10 Fig, 1 Tab, 1 Ref.

Descriptors: *Frazil ice, *Ice cover, *Ice formation, Rivers, Water flow, Flow velocity, Line sets, Experimental data.

Laboratory and field tests were performed on frazil ice collector lines to discover methods of promoting solid ice cover formation in fast flowing, shallow river sections. Line sets were composed of nylon parachute cord, nylon twisted rope, nylon braided line, and a combination of nylon, steel, brass, and aluminum, with 1 to 40 lines and different line lengths and spacings. Laboratory tests using a refrigerated flume were conducted with flume depths of 2-22 cm and average flow velocities of 0.08-0.84 m per sec. The tests in small mountain rivers 33-50 cm deep had average flow velocities of 0.6-0.8 m per sec. In the flumes at -23 to -26 C, frazil ice collected rapidly on the test lines, typically reaching a diameter of 3.2 cm in 15 min. Density of the drained ice was 470 kg per cu m, and porosity was 49%. The best river test results were obtained from a set of 20 lines, 3.2 mm diameter, 4.9 m long at a spacing of 38 mm and placed parallel to the streamflow. An ice cover 0.9 m wide and 5 m long formed overnight at about -20 C in swift water, 0.7 m per sec. Ice covers formed either from frazil ice collecting on submerged line sets and then floating to the surface or on lines initially floating. Possible applications for frazil collectors are fringed ice booms, a reinforced ice cover for a power canal or shallow stream, and ice sheet anchors to stabilize large ice sheets. (Cassar-FRC)
W82-04460

CONVECTION PATTERNS IN A POND,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
K. B. Katsaros.
Bulletin of the American Meteorological Society, Vol 62, No 10, p 1446-1453, October, 1981. 5 Fig, 18 Ref.

Descriptors: *Convection, Stratification, *Thermal stratification, *Ponds, *Ice, Ice cover, Snow, Flow pattern, *Slush.

Unusual convection patterns were noted in snow-slush on a pond in Seattle, Washington, during January of 1980 and again during February of 1981. The patterns resemble a spoke-type convection discovered experimentally by Busse and Whitehead in 1974. The first reference to large-cell patterns on a pond was made in Surrey, England, in 1946. Similar findings were reported in 1958 concerning a pond in Darmstadt, Germany, with one or two open spots in the centers. The pond in current question is a shallow and seasonal one, drying up in the summer and filling from rains in the fall. No discernible inflow or outflow exists. Temperatures at the bottom of the pond were 1.5 to 2 degrees C, while the slush layer on top was at zero degrees C and 0.08 meter in thickness. Air temperature above the pond was about 0.5 degrees C. At the time the pictures were taken, the pond was stably stratified. (Baker-FRC)
W82-04461

ACID SNOW IN THE CANADIAN HIGH ARCTIC,
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
R. M. Koerner, and D. Fisher.
Nature (London), Vol 295, No 5845, p 137-140, January 14, 1982. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Snow, *Chemical analysis, Precipitation, Snow sampling, Arctic regions, *Air pollution effects, Environmental effects, *Acidity, Canada, *Ice, Arctic, Ellesmere Island.

Acid concentrations in ice from part of a 337 meter surface to bedrock core taken on northern Ellesmore Island are presented. The sample represents the past 5000 years and was compared with the significantly higher acid concentrations occurring in snow deposited over the past 25 years at the same location, showing seasonal variations in the concentrations which together constitute a significant trend of increasing acid levels over the past 25 years. The most highly acid snow is located at the snow surface when melt begins in May or June in the high Arctic. Unless this melt refreezes at the base of the snowpack, the first runoff in spring will be the most acid. Acid levels in high Arctic snow and their effects should be monitored, especially in areas where the lake fish form a source of Inuit income. Concentrations of sodium, calcium, potassium, and magnesium along with insoluble particulates were also maximum in the spring. (Baker-FRC)
W82-04542

SEVERE SNOWMELT RUNOFF IN NORTH-EAST ENGLAND AND ITS IMPLICATIONS,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-04648

2D. Evaporation and Transpiration

SPACING AND TRANSPIRATION OF VARIOUS SIZED CLUMPS OF A DESERT GRASS, HILARIA RIGIDA,
California Univ., Los Angeles, Dept. of Biology.
P. S. Nobel.
Journal of Ecology, Vol 69, No 3, p 735-742, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Transpiration, *Plant tissues, Desert grass, Grasses, Carbon dioxide, *Roots, Groundwater, *Desert plants, Soil-water-plant relationships.

Within-species competition between clumps of the grass Hilaria rigida was investigated using conventional plotless techniques and also by root excava-

tions. Root distribution was determined and leaf water vapor conductance measured. Larger clumps were found further from a random point as well as separated from their nearest neighboring plants by greater distances than smaller clumps. Larger clumps had more ground area available for their roots. The larger space occupied by the larger clumps presumably reflected their preemption of ground water. On the smaller clumps of less than 10 culms, leaves had a three fold higher rate of transpiration per unit leaf area than had leaves on larger clumps, of over 200 culms. However, the larger clumps had nearly three times as much leaf area per unit ground area. Therefore the depth of water transpired daily did not depend on the size of the clump. Since the amount of carbon dioxide fixed per unit ground area also did not change with clump size, the pattern of small and large clumps may be quite persistent over time. (Baker-FRC)
W82-04295

BLANEY-CRIDDLE COEFFICIENTS FOR WESTERN TURF GRASSES,
Wyoming Univ., Laramie.
J. Borrelli, L. O. Pochop, W. R. Kneebone, I. L. Pepper, and R. E. Danielson.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 333-341, December, 1981. 6 Tab, 15 Ref.

Descriptors: *Consumptive use, *Evapotranspiration, *Turf grasses, *Semiarid lands, *Water supply development, Evaporation, Transpiration, Grasses, Semiarid climates, Urban areas, Water requirements, Water supply, Vegetation effects, Mathematical studies.

Very little data exists on calculating the consumptive use of water by turf grass. Some data on turf grass evapotranspiration recorded from lysimeter studies over extended periods at various locations were used to calibrate a Soil Conservation Service (SCS) modification of the Blaney-Criddle technique of calculating evapotranspiration. Results obtained from the revised method should be useful in yielding fairly accurate estimates of city wide water requirements for turfed areas typical of the western United States for use in long range water supply evaluations. Data from these SCS calculations showed that warm season turf grasses should be used in warm regions because they consume considerably less water than other types. In transition areas with summer temperatures over 25 degrees, cool season grasses may undergo heat stress and suffer a decrease in evapotranspiration rates. (Geiger-FRC)
W82-04310

***USE OF MODIFIED BLANEY AND CRIDDLE* FORMULA FOR ESTIMATING WATER REQUIREMENTS,**
Meteorological Office, Poona (India).
K. Subba Rao, and G. Yazdani.
Mausam, Vol 32, No 2, p 195-200, April, 1981. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Evapotranspiration, *Water requirements, Evaporation, *Irrigation requirements, *India, *Rice, *Sugarcane, Blaney and Criddle method, Crop growth stage coefficient.

Experimental values of the crop growth stage coefficient (Kc) were determined for paddy and sugarcane from lysimeter data recorded at four locations in India. Kc gradually increased with advancement of the crop season, reached a peak at about 65% of the growing season, and then declined. This seasonal variation was similar to potential evaporation. Kc values for sugarcane were 0.6-1.1 and for paddy, 0.5-11, 0.6-1.4, and 0.7-0.9 at 3 locations. Ratios of potential evapotranspiration to pan evaporation were 0.9-1.7 for paddy and 0.5-2.0 for sugarcane. The modified Blaney and Criddle method was used to compute evapotranspiration using Kc derived in this work. Differences from measured values for paddy ranged from -6.4 to 16.8 mm. Previous work, which probably used Kc unsuitable for these locations, obtained values differing from the observed values by -40.6 to +29.0. (Cassar-FRC)
W82-04667

MODELLING EVAPORATION FROM RESERVOIRS,
Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Hydrological Sciences Bulletin, Vol 26, No 4, p 363-367, December, 1981. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Mathematical models, *Reservoirs, *Water temperature, *Numerical analysis, *Reservoir evaporation, Lakes, Water management, Thermal stratification, Evaporation, Seasonal variation, Energy loss, Evaporation rate, Lake evaporation.

The greater thermal capacity of large reservoirs often delays the response of water temperature to changes in insolation and air temperature, offsetting the usual patterns of increased evaporation in the summer. A finite differences numerical model for predicting water temperature in the vertical dimension in freshwater reservoirs is described that is based on the annual variation of evaporation. The model is applicable to both small and large lakes, and the seasonal change in peak evaporation from summer (in small lakes) to winter (in large lakes) is satisfactorily simulated. Some differences in actual and model conditions may be observed, especially in March and August, due to the large spatial averaging inherent in both observations and calculations. In areas where water supplies are short, accurate calculations of evaporation rates may be vital to the planning of water management strategies. (Geiger-FRC)
W82-04722

2E. *Streamflow and Runoff*

***RELATION BETWEEN CURVE NUMBER AND* RUNOFF COEFFICIENT,**
Maryland Univ., College Park. Coll. of Engineering.
For primary bibliographic entry see Field 2A.
W82-04266

ELEVATION: A MAJOR INFLUENCE ON THE HYDROLOGY OF NEW HAMPSHIRE AND VERMONT, USA,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
S. L. Dingman.
Hydrological Sciences Bulletin, Vol 26, No 4, p 399-413, December, 1981. 8 Fig, 13 Ref.

Descriptors: *Streamflow, *Snowmelt, *Elevation, *Prediction, *Drainage area, *Alpine regions, Overland flow, Air temperature, Evapotranspiration, Altitude, Flood peak, Precipitation, Catchment areas, Runoff, Hydrologic data, Data collections, Orography, Vermont, New Hampshire.

Elevations in Vermont and New Hampshire are generally very high, with many mountain peaks exceeding 1200 m in height. As elevation increases, so does the mean annual and mean monthly precipitation, snow depth, and snow water equivalents, while mean monthly temperatures decreases. Temperature from National Weather Service networks may be used in conjunction with other data to illustrate how potential evapotranspiration fluctuares with elevation. These combined parameters exert strong elevational increases in mean annual streamflow and cause both short term and annual streamflow variability to decrease with the mean elevation of the drainage basin. As mean basin elevation increases above 340 m, low flows for a given exceedance probability show marked increases. For a given return period, flood peaks are also enhanced with increases in mean basin elevation. Although slope and aspect influence the timing of snowmelt runoff, these values exert little effect on hydrology. Usually elevation can be used as the single independent variable for predicting streamflow parameters. (Geiger-FRC)
W82-04304

CONFORMAL MAPPING FOR CHANNEL JUNCTION FLOW,
Malviya Regional Engineering Coll. Jaipur (India). Dept. of Civil Engineering.
P. N. Modi, P. D. Ariel, and M. M. Dandekar.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1713-1733, December, 1981. 7 Fig, 4 Tab, 2 Ref.

Descriptors: *Channel flow, *Flow characteristics, Streamflow, Hydraulics, Conformal mapping, Mapping, Open-channel flow, Stagnant water, Free-streamline theory, Mapping, *Channel junction flow.

Analysis of flow behavior at channel junctions where two streams combine to form a third is extended to cases with any junction angle and different bed widths. The solution was obtained with the aid of conformal mapping. For small values of the discharge ratio (discharge in channel 2 less than in channel 1) the stagnation point is along the channel 2 boundary closest to channel 1. In the opposite case, greater discharge in channel 1, the stagnation point coincides with the upstream corner at the junction point of the 2 channels. Relationships are developed for the location of the stagnation point with respect to junction angle and the ratio of bed widths of the two channels. For different locations of the stagnation points in the channel junctions, the solutions of the equation for the free-streamline are presented in dimensionless form. The location of the zone of stagnant fluid between the free-streamline and the channel boundary changes with changes in junction angle and as the stagnation point shifts from one channel to the other. (Cassar-FRC)
W82-04306

RELATIVE RUNOFF BY CURVE NUMBER NOMOGRAPH,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-04307

FLOOD PROBABILITY ESTIMATION,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W82-04318

HYSTERESIS IN RELATIONSHIPS BETWEEN DISCHARGE AND WATER CHEMISTRY IN THE FRASER RIVER BASIN, BRITISH COLUMBIA,
Department of the Environment, Vancouver (British Columbia).
For primary bibliographic entry see Field 2K.
W82-04326

DETENTION BASINS--AN URBAN EXPERIENCE,
Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 4A.
W82-04332

ESTIMATION OF EXTREME LOW FLOWS FOR PUMPED STORAGE RESERVOIR DESIGN,
Newcastle upon Tyne Univ., (England). Dept. of Engineering Mathematics.
A. V. Metcalfe, and J. A. Mawdsley.
Water Resources Research, Vol 17, No 6, p 1715-1721, December, 1981. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Reservoir design, *Drought, *Low flow, River flow, *Flow augmentation, Poaka Beck reservoir, Crake River, *United Kingdom, Reservoir storage, Pumped storage, Minimum flow, Water transfer.

A model was developed for estimating extreme low flows with a certain probability of nonexceedance for reservoirs where natural inflow from a river is supplemented by pumping from an adjacent river. The method is based on the joint probability distribution of an extreme value distribution and a truncated extreme value distribution. The

estimates of the probabilities of given low flows are made using integrals which are evaluated numerically for a range of low flows and maximum daily pumping rates. Results obtained by applying the derived density function to 25 years of data from the Poaka Beck reservoir and the River Crake in northwest United Kingdom are given for a 3-month drought. This detailed model has several advantages: effects of varying parameters can be studied, flow sequence simulation is not necessary if a suitable distribution for pumped flows can be hypothesized, and the distributional models suggested for the low flows of the two streams are easier to justify than any other particular choice of distribution. (Cassar-FRC)
W82-04334

STORM RUNOFF ANALYSES ON THREE SEMI-ARID CATCHMENTS,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W82-04339

RECONSTRUCTED STREAM FLOW FOR THE SALT AND VERDE RIVERS FROM TREE-RING DATA,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
L. P. Smith, and C. W. Stockton.
Water Resources Bulletin, Vol 17, No 6, p 939-947, December, 1981. 6 Fig, 5 Tab, 20 Ref.

Descriptors: Floods, Droughts, *Dating, *Streamflow, *Salt River, *Verde River, *Arizona, Trees, History, Flood peak, Precipitation, Planning, Water supply, Tree rings technique.

Tree ring data were used to extend streamflow records of the Salt and Verde Rivers, Arizona, back to 1580 A.D. The reconstruction of streamflows indicates that the available gaged records dating back to 1889 contain an above average number of high seasonal and annual flows when compared with the 400 year period. Peak flows may be similarly biased, making designs based on historical records of peak flow conservative. The average frequency of occurrence of annual and seasonal discharges associated with the peak flows has remained constant over the 400 year mean. Therefore, water supplies estimated using the historical means may be overestimated. Several long periods of low annual discharge, more severe than in the 1890 to present period, occurred on the average of every 22 years during the reconstructed period. In the Salt River Basin 1905-1920 was the wettest period in the 400 year period. A severe 5 year drought ended in 1670. Another low flow period was 1728-1739, during which average annual discharge was only 43% of the 400 year mean. The Verde River basin had high flows in the early 1900's and low flows at the turn of the century. The most severe drought was in the mid-1770's to mid-1780's. A possible low flow period, based on only 1 tree ring series, was 1580-1620. In general low and high flows in the Verde River coincided with those in the Salt River. (Cassar-FRC)
W82-04340

COMPARISON OF TWO AUTOREGRESSIVE MODELS FOR MONTHLY STREAM FLOW GENERATION,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and M. A. Khan.
Water Resources Bulletin, Vol 17, No 6, p 1035-1041, December, 1981. 8 Tab, 28 Ref.

Descriptors: *Streamflow, *Stochastic hydrology, Model studies, Reservoir storage, Thomas-Fiering model, Spolia-Chandler model, *Comparison studies, Laos, Thailand, Cambodia.

Two closely-related autoregression models for monthly streamflow generation were compared by theoretical consideration and practical applications to flow data from stations in Laos, Thailand, and Cambodia. The Thomas-Fiering model (1962) was superior to the Spolia-Chandler model (1974). The latter model is a reduced parameter modification of the Thomas-Fiering model. Errors in the reproduction of the correlation coefficient and skewness coefficient by the Thomas-Fiering model occurred during months when parameters are nearly zero. This is considered a remediable situation. The gamma random generator produced better results than the lognormal random generator in most cases. (Cassar-FRC)
W82-04351

SEARCH: A GAGED WATERSHED INVENTORY,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 10B.
W82-04433

ANALYSIS AND PREDICTION OF WATER MOVEMENTS AND WATER QUALITY IN A SHALLOW RIVER IMPOUNDMENT. APPLICATION TO MISSISSIPPI RIVER POOL NO 2,
For primary bibliographic entry see Field 7B.
W82-04482

FLOOD AND RELATED DEBRIS FLOW HAZARDS MAP, LAS VEGAS SE QUADRANGLE,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04490

WATER RESOURCES INVENTORY OF CONNECTICUT, PART 7, UPPER CONNECTICUT RIVER BASIN,
Geological Survey, Hartford, CT. Water Resources Div.
R. B. Ryder, M. P. Thomas, and L. A. Weiss.
Connecticut Water Resources Bulletin No 24, 1981. 78 p, 41 Fig, 23 Tab, 76 Ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Hydrologic data, Hydrologic cycle, Aquifers, Aquifer characteristics, Wells, Water supply, Streamflow, Sediment transport, Precipitation, Runoff, Chemical analysis, Maps, *Connecticut, *Upper Connecticut River basin.

The 508 square-mile upper Connecticut River basin during the 1931-60 period received an average of 44 inches of precipitation per year; evapotranspiration averaged 22.2 inches per year while inflow from streams was approximately 4,060 billion gallons per year. Flow out of the basin in the Connecticut River at Portland, Conn., averaged 4,230 billion gallons per year. In 1968, freshwater use was estimated at 108,547 million gallons, a small fraction of the total available. Ground-water sources in the basin yield from several million gallons per day at large well fields to 1 gallon per minute from single wells. Stratified-drift aquifers are the most productive and individual well yields of 100 gallons per minute or more are common. Bedrock aquifers that underlie the basin generally yield a few gallons a minute and are adequate sources for domestic supply. Surface-water samples collected at 25 sites in the area had median dissolved-solids concentrations of 113 milligrams per liter at high flow and 148 milligrams per liter at low flow. Ground-water samples from 164 wells had dissolved-solids concentrations that ranged from 52 to 2,060 milligrams per liter. High concentrations of iron, manganese, sulfate, sodium, and hardness cause ground-water quality problems in parts of the area. (USGS)
W82-04505

MEAN ANNUAL STREAMFLOW OF SELECTED DRAINAGE BASINS IN THE COAL AREA OF SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-04506

SELECTED HYDROLOGIC RELATIONSHIPS FOR SOLDIER CREEK, NORTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
W. J. Carswell, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-138751, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-8, 1981. 68 p, 36 Fig, 7 Tab, 21 Ref.

Descriptors: *Streamflow, *Water quality, *Precipitation, *Flow characteristics, Low flow, Flow duration, Fluvial sediments, Sediment discharge, *Kansas, Soldier Creek basin, Flood frequency, Comparison studies.

Hydrologic data from Soldier Creek basin, northeastern Kansas, were compared with relations from statewide data. The quantity and quality of streamflow were affected mostly by soils, slopes, and land use. Average annual precipitation during the study (1964-76) was 35.12 inches, or 2.3 percent greater than the long-term (1929-76) average. The average streamflow in Soldier Creek at Topeka was 23 percent greater than the long-term average. In general, frequency curves of annual peak discharges compared poorly with curves from statewide relations due to the absence of extremely low peaks during the short period. A comparison of low-flow frequency for drainage areas of more than 100 square miles suggests that reasonable results may be obtained by extrapolating the statewide relations to small basins. Comparisons of flow-duration curves confirms the extrapolation for basins of less than 100 square miles, although the percentage duration of mean flow is variable. Water surveys showed that calcium, bicarbonate, and sulfate were the predominant ions and dissolved solids were derived mostly from limestones and shales. Suspended sediment at gaged sites ranged from 9.84 to 848 tons per days; yield per unit area increased significantly between two sites due to changes in slopes and land use. (USGS)
W82-04519

DISASTER BY FLOOD,
National Oceanic and Atmospheric Administration, Boulder. Environmental Research Labs.
L. R. Hoxit, H. S. Lieb, C. F. Chappell, and H. M. Mogil.
In: Thunderstorms: A Social, Scientific, and Technological Documentary, Vol I, The Thunderstorm in Human Affairs, NOAA, September, 1981. p 23-45, 15 Fig, 27 Ref.

Descriptors: *Thunderstorms, *Flash floods, Precipitation, Flood forecasting, *Flood damage, Disasters, Flooding, Rainfall distribution, Warning systems, Canyons, *United States.

During the 1970's flash floods were the leading cause of death and destruction from weather-related causes; they have devastated parts of nearly every state. More than 15,000 communities and recreational areas have been identified as vulnerable to flash floods. Increased use of mountainous areas for recreation and canyons for home building has greatly increased the potential for disaster. The Big Thompson Canyon flash flood of 1976 is an example of the meteorological processes, the problems of warning and preparedness, and the human response to floods. Intense thunderstorms produced up to 12 inches of localized rainfall within a few hours over the rugged Big Thompson River drainage in north-central Colorado. The normally placid river received great quantities of water from several tributaries. Near Drake, the flow on the river just before the rain began was 137 cfs; the peak flow was 31,200 cfs. Only a few hours separated the onset of heavy rain from the flood crest passing the canyon mouth. The phenomenal local episode was appreciated only after it was under way, and many people either disregarded warnings or received no warning. The flash flood that swept through the canyon and onto the plains resulted in 139 casualties and property damage estimated at $35 million. The toll taken by flash floods in the future will be determined by the nature and density of settlements, the quality of flood control measures, the systems used for acquiring and interpreting meteorological observations, forecast and

warning communications, and responses to warnings. (Moore-SRC)
W82-04618

THE DISASTROUS SOUTHERN CALIFORNIA AND CENTRAL ARIZONA FLOODS, FLASH FLOODS, AND MUDSLIDES OF FEBRUARY 1980,
National Weather Service, Silver Spring, MD.
Natural Disaster Survey Report NWS-81-1, March, 1981. 128 p, 28 Fig, 3 Tab, 7 Append.

Descriptors: *Floods, *Flash floods, Flood forecasting, *Mudflows, Rainfall distribution, Weather forecasting, Warning systems, *Flood damage, *California, *Arizona.

For 9 days during mid-February 1980, the southwestern U.S. was battered by a series of heavy rainstorms. Over the period, 5 inches or more of rain fell over most of Southern California's coastal valleys, and some mountain areas received over 25 inches. Rainfall amounts in Central Arizona ranged from 1 to over 16 inches. The large rainfall amounts produced floods and flash floods in many areas, and mudslides were a major problem in Southern California. Overall, the NOAA warning systems worked well in both California and Arizona. The Los Angeles Weather Service Forecast Office (WSFO) issued watches, warnings, and statements well in advance of flooding, flash flooding, and mudslides. The Phoenix WSFO also issued timely flood/flash flood watches, warnings and statements. All indications are that the NOAA services contributed significantly to reducing property losses and probably deaths. Nevertheless, 21 people died as a direct result of flooding, flash flooding, and mudslides; and total property damage in the two states topped $400 million. Part of these losses might have been prevented if, in some cases, more effective action had been taken on the part of the public. One factor that apparently contributed to citizen inaction during this disaster was the inability to give a more precise description of the rainfall distribution in the warning statements. (Moore-SRC)
W82-04632

THE DEVELOPMENT OF A VIABLE METHOD OF STREAM FLOW MEASUREMENT USING THE INTEGRATING FLOAT TECHNIQUE,
Lancaster Univ., Bailrigg (England).
For primary bibliographic entry see Field 7B.
W82-04643

SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 4, p 1023-1035, December, 1981. 7 Fig, 2 Tab, 3 Ref.

Descriptors: *Flood forecasting, Risks, *Seasonal variation, *Flood frequency, *England, Rainfall-runoff relationships, Soil water, Storm water, Streamflow forecasting.

A method for seasonal flood analysis is presented. It is based on the percentage of the annual number of floods above a given return period occurring in each month. Variations in seasonal regime are identified for stations in northeast England. These are related to controlling factors of storm rainfall and catchment wetness. A graph depicts the relationship between construction period/design life, return period, and the risk of flood occurrence. A table gives the percentage of annual number of flood events above a given return period occurring each month in three regions. This method can determine the seasonal flood risks to crops grown on a flood plain or to construction projects such as bridges, outfalls, and piers. (Cassar-FRC)
W82-04646

SEVERE SNOWMELT RUNOFF IN NORTHEAST ENGLAND AND ITS IMPLICATIONS,
Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 4, p 1049-1060, December, 1981. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Flood forecasting, *Snowmelt, *Runoff rates, Forecasting, Snow density, Snow depth, Melting, Streamflow forecasting, *England.

Measured snowmelt runoff rates in northeast Britain were considerably higher than those obtained from meteorological data. Analysis of snowmelt rates in 1978-97 confirmed earlier observations of runoff rates. The differences in rates were attributed to limitations in data on which the meteorological conclusions were based. No deep snowpacks were included in the estimates of water equivalent depletion. Rates of depth depletion do not directly indicate melt or yield. Densities of snowpacks in the uplands were also much higher than in the lowlands because of higher windspeeds, greater compaction due to deeper snow, and lower temperatures. These discrepancies can cause underestimates of probable maximum floods. (Cassar-FRC)
W82-04648

WATER QUALITY MONITORING - IDENTIFICATION OF RESIDENCE/TRAVELLING TIMES FROM HYDROLOGICAL AND WATER QUALITY INFORMATION,
Karlsruhe Univ. (Germany, F.R.).
G. Troubounis, H. H. Hahn, and B. Eppler.
Water Science and Technology, Vol 13, No 11/12, p 677-682, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality, *Monitoring, Water pollution control, Hydrologic data, Rivers, Data collections, Data acquisition, Detection times, Detention time, Streamflow.

The corresponding residence or travelling time between monitored river cross sections is a necessary piece of information in conceiving a river quality monitoring program. This traveling or transit time is a function of the discharge rate of the river itself. The problems encountered in residence/traveling time determinations are discussed. Two methods are described which are more compatible with water quality considerations than the well known hydraulic computations: the use of iso-concentration graphs based on data for concentration changes of conservative water constituents, and time series analysis methods. Comparing the computed flow and traveling times between predetermined cross-sections, one finds significant differences between hydraulically computed data and those determined on the basis of water quality measurements. It is concluded that if automatic sampling or quasi- continuous analyses exist, then such data will form a sufficient basis for the determination of residence and traveling times in free flowing as well as impounded rivers. If periodic variations or oscillations in the quality of a river exist, then such quasi-continuous or continuous measurements on concentration changes of conservative substances can be used for a detention time determination on the basis of iso-concentration diagrams. If no periodic fluctuation in the concentration of conservative water constituents can be observed, but non-conservative substances are available, then the method using the cross-correlation function should be employed. (Baker-FRC)
W82-04663

STATISTICAL FORECASTING OF HEAVY RAIN AND FLOODS IN THE RIVER TEESTA,
Flood Meteorological Office (India).
For primary bibliographic entry see Field 2B.
W82-04670

THE FUTURE OF FLOOD ESTIMATION AND THE FLOOD STUDIES REPORT,
Northumbrian Water Authority, Gosforth (England).
P. Johnson.
Proceedings of the Institution of Civil Engineers. Part I. Design and Construction, Vol 70, No 3, p 833-843, 1981. 1 Tab.

Descriptors: *Flood flow, *Flood plain management, *Spillway capacity, *Rainfall, *Snowmelt, Floof forecasting, Flood-control storage, Floods, Data collections, Urban areas, Catchment areas, Runoff, Reservoirs, *United Kingdom.

The proceedings of the 1975 conference, The Flood Studies Report (FSR) held by the Hydraulics and Public Health Engineering Board of the Institution of Civil Engineers, are summarized in the committee chairman's report. Priority tasks to improve upon and extend the FSR are mainly ones of better mapping of flood boundaries, finding the adequacy of urban catchment, and estimating more accurately the trends and cycles of floods. Several priority tasks for updating the FSR will require more sophisticated and broader data base analyses. The REGIME concept for relating discharge to river channel cross-sectional areas and other features should be studied for application to the FSR. The URBAN program was adopted to aid in estimating flood discharges in or as a result of urban areas. Radar is suggested for more accurate data collections on rainfall. Information on snowmelt also needs more development. Plans were made to survey all major spillways in the British Isles and to examine wind velocities and directions of storms causing flood inflow. Recommendations to expand data on reservoirs in an engineering guide were also made. Extrapolation of FSR methods for use overseas and training in the proper understanding of the report are considered. (Geiger-FRC)
W82-04687

RESISTANCE EQUATION FOR LARGE-SCALE ROUGHNESS,
Institute of Hydrology, Wallingford (England).
J. C. Bathurst, R. M. Li, and D. B. Simons.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1593-1613, December, 1981. 11 Fig, 8 Tab, 21 Ref.

Descriptors: *Channel flow, *Flow resistance, *Hydraulic roughness, Flumes, Reynolds number, Rocks, Roughness coefficient, Froude number, Channel morphology, Resistance, *River beds, Bed material, Particle size, Mountain streams.

Flow in channels with large-scale roughness, such as boulder-bed channels increasingly being used in developing mountainous areas, was investigated in a steep stream flume. Bed material was of five different sizes, from 0.5 to 2.5 inches. A flow resistance equation was developed for this situation, in which the ratio of flow depth to mean element height was less than 4. The flow resistance in large-scale roughness depended on the form drag of the elements and their deposition in the channel. The relevant processes of flow were described as functions of Reynolds number, Froude number, roughness geometry, and channel geometry. Values predicted by this equation and by other workers for the Upper River Tees, United Kingdom, were compared with observed values. Agreement was generally good, but further refinement is necessary to account for variations in channel width and element shape. (Cassar-FRC)
W82-04696

2F. Groundwater

A GROUND WATER RESOURCES STUDY OF A PACIFIC OCEAN ATOLL--TARAWA, GILBERT ISLANDS,
Birmingham Univ. (England). Dept. of Geological Sciences.
J. W. Lloyd, J. C. Miles, G. R. Chessman, and S. F. Bugg.
Water Resources Bulletin, Vol 16, No 4, p 646-653, August, 1980. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Groundwater potential, *Resistivity, *Atolls, Groundwater availability, Groundwater management, *Tarawa, *Gilbert Islands, Water supply, Drought, Aquifers, Lenses, Islands.

Groundwater resources were investigated in Tarawa, Gilbert Islands, typical of thousands of small atolls in the Pacific Ocean. Surface resistivity

measurements were combined with an electrical conductivity survey of well waters to establish the size and shape of fresh water lenses. Most wells in this atoll intercept only the top edge of the lens. Although precipitation is the controlling factor for groundwater recharge input, there is a 15% interception loss. Steady state conditions were not appropriate for modeling water resources in this atoll because long periods occur during which there is no recharge. Therefore nonsteady digital modeling methods were used to analyze the groundwater resources in the largest 4 of the 8 atolls in the Tara group. Results of the study showed that the 4 main lenses can supply water adequately for a 2% drought of 2-year duration. To prevent saline water intrusion, water should not be abstracted during the second year of a drought. Once a lens has been overabstracted, it may not recover. Increasing populations in these islands, the susceptibility of lens resources to drought, and the expense and difficulty of obtaining alternate intermittent water supplies are problems common to many Pacific atolls. (Cassar-FRC)
W82-04254

DELAYED DRAINAGE IN A STREAM-AQUIFER SYSTEM,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 407-410, December, 1981. 1 Fig, 7 Ref.

Descriptors: *Groundwater movement, *Subsurface drainage, *Mathematical models, *Drainage wells, *Unconfined aquifers, Aquifers, Drainage, Model studies, Hydrologic models, Mathematical studies, Water table, Mathematical equations, Flow patterns, Fully penetrating wells, Streams.

An explanation of Higgins' results for nonsteady flow from an unconfined aquifer into a fully penetrating stream in which the water level fluctuates in a prescribed pattern was developed which does not account for unsaturated flow. The proposed theory is similar to that of Higgins, except that the aquifer material is assumed to be uniformly elastic and the water compressible, and the aquifer itself is assumed to be anisotropic. The new theory is based on the concept of delayed drainage as applied to the problem of unconfined flow to a well. At small values of time, the water table drawdowns observed experimentally by Higgins exceeded those predicted by his theory, while at large values of time, some of the water table drawdowns observed by Higgins were less than those predicted by his theory. A simple explanation of how this situation occurs and equations to remedy this problem are presented. (Geiger-FRC)
W82-04268

THE SEEPAGE FLOW THROUGH A FREE BOUNDARY AQUIFER INTO A RIVER,
Reading Univ. (England). Dept. of Mathematics.
J. O'Shea, and M. J. Baines.
Hydrological Sciences Bulletin, Vol 26, No 4, p 415-411, December, 1981. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Groundwater movement, *Mathematical models, *Numerical analysis, Model studies, Hydrologic models, Aquifers, Mathematical studies, Mathematical equations, Rivers, *Influent streams.

A model of groundwater flow from an aquifer beneath a river into the river channel is presented in order to determine the discharge q into the river for different values of the boundary data, namely at the river boundary and at the outer edge of the aquifer. Information from this model may be applied for calculating the total water conten in a river or the inflow conditions when modeling water systems. The solution procedure for solving Laplace's equation utilizes a variational inequality, which yields a numerical approximation solution using finite differences. The discharge parameter q is determined from Neumann boundary conditions and iterations on q using a compatibility condition obtained by the discretizing of discharge equations. (Geiger-FRC)
W82-04305

SOIL PERCOLATION RATES FROM NEUTRON PROBE MEASUREMENTS,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 4B.
W82-04309

HYDROLOGIC EFFECTS FROM CHANGES IN GROUND WATER PUMPAGE,
International Engineering Co., Incorp., San Francisco, CA.
M. V. Damm.
Water Resources Bulletin, Vol 16, No 5, p 907-913, October, 1980. 11 Fig, 2 Tab, 8 Ref.

Descriptors: *Groundwater, *Pumpage, Aquifers, Recharge, River basins, Simulation, *Groundwater recharge, Model studies, *Hydrologic budget, Nebraska.

The purpose of this paper is to explore the hydrologic effects of implementing an allocation scheme in an area where groundwater pumpage provides a substantial portion of the applied water. In general a reduction of pumped groundwater applied at the surface will result in less recharge to the groundwater body. Recharge will decrease in an amount approximately equal to the decrease in pumpage, as long as the water pumped is in excess of actual water needs. Simulation of a stream-aquifer system in Nebraska was undertaken to determine estimates of the effects of controls on groundwater withdrawals. Due to uncertainties in the calibration processes and projections of various types of data and to simplifications employed in the models, the results of the simulation most likely include some error. The relatively small savings from reductions in pumpage result primarily from recirculation effects. Differences between groundwater contributions to stream flow were small for all simulations examined. These contributions decreased with time and increased pumpage amounts. base flow rates at the end of the simulation were about 25% of those at the beginning. (Baker-FRC)
W82-04428

THE USE OF LANDSAT IMAGERY IN GROUND WATER EXPLORATION,
Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
For primary bibliographic entry see Field 7B.
W82-04436

A LUMPED APPROACH TO THE INVERSE PROBLEM IN GROUND WATER HYDROLOGY,
Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W82-04451

A NUMERICAL LINKED MODEL FOR THE PREDICTION OF THE DECLINE OF GROUNDWATER MOUNDS DEVELOPED UNDER RECHARGE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. A. Kashkuli.
PhD Thesis, July, 1981. 159 p, 21 Fig, 7 Tab, 59 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-26436.

Descriptors: *Model studies, *Mathematical models, *Groundwater recharge, Groundwater movement, Saturated flow, Water table, *Groundwater mounds.

A model is developed to couple the approximate solution of one-dimensional vertical partially saturated flow to the two-dimensional saturated horizontal flow. The linked model is used to predict the decline of a groundwater mound developed under recharge areas. It consists of linking beneath the recharge area one-dimensional vertical unsaturated columns to a two-dimensional areal saturated flow model. Besides the Dupuit-Forchheimer assumptions in the saturated flow, it is further assumed that the partially saturated flow is vertical. The solution of the equation governing the partially saturated flow above the water table determined the recharge and storage information needed for the solution of the saturated flow equation. The model simulates the lateral unsaturated flow by an equivalent permeable height and uses an equivalent saturated height to account for a changing specific yield. The model was verified by comparing the results for a certain problem to those predicted by a rigorous model. A field size problem of strip recharge was simulated and solved. It was found that for this particular problem the water table decline rate is considerably faster if the traditional approach of excluding the unsaturated flow region is employed. In this model both Su-Brooks and Brooks-Corey methods for determining soil parameters can be used. (Sinha-OEIS)
W82-04481

GROUND-WATER CONDITIONS IN THE UPPER VIRGIN RIVER AND KANAB CREEK BASINS AREA, UTAH, WITH EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 6D.
W82-04486

DIGITAL MODELS OF GROUND-WATER FLOW IN THE CAPE COD AQUIFER SYSTEM, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
J. H. Guswa, and D. R. LeBlanc.
Geological Survey Open-File Report 80-67 (WRI), 1981. 128 p, 60 Fig, 12 Tab, 19 Ref.

Descriptors: *Groundwater, *Computer models, *Coastal aquifers, *Unconfined aquifers, Groundwater movement, Saline-freshwater interfaces, Regional development, Prediction, Hydrologic data, Finite difference methods, *Massachusetts, *Cape Cod.

The Cape Cod aquifer system was simulated with three-dimensional finite-difference ground-water-flow models. Five areas were modeled to provide tools which can be used to help predict the hydrologic impacts of regional water development and disposal schemes. Model boundaries were selected to represent the natural hydrologic boundaries of the aquifer. The boundary between fresh and saline ground water is treated as an interface of no dispersion, and the saline-water zone is treated as being non-flowing. Comparisons of calculated and observed head values, position of the freshwater and saline-water boundary, and ground-water-discharge rates at locations where data are available indicate that the simulated ground-water reservoirs generally agree with the field conditions and the models can be used for predictive studies. (USGS)
W82-04487

MAPS SHOWING GROUND-WATER CONDITIONS IN THE BILL WILLIAMS AREA, MOHAVE, YAVAPAI, AND YUMA COUNTIES, ARIZONA--1980,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04488

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1981,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04489

TWO-DIMENSIONAL GROUND-WATER FLOW MODEL OF THE CRETACEOUS AQUIFER SYSTEM OF LEE COUNTY AND VICINITY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
J. M. Kernodle.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142852, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-70, 1981. 53 p, 28 Fig, 26 Ref.

Descriptors: *Computer models, *Groundwater, *Aquifer systems, *Water management, Geohydrology, *Groundwater movement, Observation wells, Water level, Hydraulic conductivity, Available water, *Mississippi, *Lee County, Eutaw-McShan aquifer, Gordo aquifer.

A two-dimensional ground-water flow model of the Eutaw-McShan and Gordo aquifers in the area of Lee County, Miss., was successfully calibrated and verified using data from six long-term observation wells and two intensive studies of areal water levels. The water levels computed by the model were found to be most sensitive to changes in simulated aquifer hydraulic conductivity and to changes in head in the overlying Coffee Sand aquifer. The two-dimensional model performed reasonably well in simulating the aquifer system except possibly in southern Lee County and southward where a clay bed at the top of the Gordo Formation partially isolated the Gordo from the overlying Eutaw-McShan aquifer. The verified model was used to determine theoretical aquifer response to increased ground-water withdrawal to the year 2000. Two estimated rates of increase and five possible well field locations were examined. (USGS)
W82-04492

BOREHOLE DATA-COLLECTION METHODS APPLICABLE FOR THE REGIONAL OBSERVATION AND MONITOR WELL PROGRAM, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04493

EFFECT OF IRRIGATION PUMPING ON THE GROUND-WATER SYSTEM IN NEWTON AND JASPER COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04497

GEOHYDROLOGIC RECONNAISSANCE OF THE CROFTON UNIT, NORTHEASTERN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04498

WATER RESOURCES INVENTORY OF CONNECTICUT, PART 7, UPPER CONNECTICUT RIVER BASIN,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04505

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1981,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04507

PROBABLE HIGH GROUND-WATER LEVELS ON CAPE COD, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04511

PRELIMINARY DATA FROM ARBUCKLE TEST WELLS, MIAMI, DOUGLAS, SALINE, AND LABETTE COUNTIES, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04512

CARBONATE GEOCHEMISTRY OF VADOSE WATER RECHARGING LIMESTONE AQUIFERS,
Kentucky Univ., Lexington. Dept. of Geology.
J. Thrailkill, and T. L. Robl.
Journal of Hydrology, Vol 54, No 1-3, p 195-208, December, 1981. 4 Fig, 3 Tab, 20 Ref. OWRT-A-009-KY.

Descriptors: *Geochemistry, *Vadose water, *Groundwater recharge, Carbonates, Aquifers, Flow, Seepage, Caves, *Limestone aquifers.

An investigation of the carbonate equilibrium of water which is transiting the vadose zone in Kentucky caves included repeated sampling at the same sites to examine possible seasonal variations. Also, measurements were made of discharge at the sources, and the pH was determined as soon as possible after the water entered the cave environment. Furthermore, the carbonate chemistry of the soil waters overlying at least some of the sites was investigated. An apparent chemical distinction could be made between vadose flows and vadose seepage, with the vadose flows being originally more undersaturated with respect to calcite. Calcite is actively dissolved as water passes through the vadose zone. Two types of vadose seepage were identified: low-Ca vadose seepage and high-Ca vadose seepage. High-Ca vadose seepage is probably the most abundant source of recharge to limestone aquifers which are not overlain by other lithologies. (Small-FRC)
W82-04526

THEORY FOR AQUIFER TEST ANALYSIS IN FRACTURED ROCK UNDER LINEAR (NONRADIAL) FLOW CONDITIONS,
Water Futures, Albuquerque, NM.
D. N. Jenkins, and J. K. Prentice.
Ground Water, Vol 20, No 1, p 12-21, 1982. 11 Fig, 13 Ref.

Descriptors: *Mathematical studies, *Aquifers, *Groundwater movement, *Pump wells, Mathematical equations, *Geologic fractures, Drawdown, Permeability, Fracture permeability, Flow pattern, Graphical methods.

If a well penetrates a geologic fracture with a permeability much greater than that of the surrounding aquifer, then the flow of groundwater in a fractured rock aquifer may be linear toward a natural production surface rather than radial toward a pumping well. Such linear flow has been discovered in fractured rock aquifers in three distinct areas of New Mexico. Similar aquifers were identified from aquifer test data in Mendocino and Placer Counties in California. Conventional methods of aquifer analysis were deemed inadequate due to curvilinear test data on semi-log plots and straight line data on log-log plots. Mathematical methods of fitting straight lines to arithmetic plots of pumped well and observation well data showed that the flow in the vicinity of the test well was linear. Flow lines in a linear system are parallel, and drawdown is a function of the perpendicular distance from the extended well. (Geiger-FRC)
W82-04676

DETERMINATION OF EFFECTIVE WELL BLOCK RADII FOR NUMERICAL RESERVOIR SIMULATIONS,
Systems, Science and Software, LaJolla, CA.
For primary bibliographic entry see Field 6A.
W82-04732

ISOTOPE GEOCHEMISTRY OF WATER IN GULF COAST SALT DOMES,
Arizona State Univ., Tempe. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-04742

INTERPRETATION OF CHEMICAL ANALYSES OF WATER COLLECTED FROM TWO GEOTHERMAL WELLS AT COSO, CALIFORNIA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1A.
W82-04743

A MODEL OF HYDROTHERMAL CONVECTION IN AN AQUIFER,
Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY.
For primary bibliographic entry see Field 1A.
W82-04744

GROUND WATER MONITORING OF UNDERGROUND COAL MINES,
Moody and Associates Inc., Meadville, PA.
For primary bibliographic entry see Field 5B.
W82-04750

2G. Water In Soils

A PROBE METHOD FOR SOIL WATER SAMPLING AND SUBSURFACE MEASUREMENTS,
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 7B.
W82-04325

TWO-DIMENSIONAL SOIL MOISTURE FLOW IN A SLOPING RECTANGULAR REGION: EXPERIMENTAL AND NUMERICAL STUDIES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W82-04333

IRRIGATION, CROP YIELD AND DRAINAGE AT THE VAALHARTS IRRIGATION SCHEME: 3. THE INFLUENCE OF SALINIZATION ABOVE A SHALLOW GROUND WATER TABLE ON THE YIELD OF WHEAT AND OTHER CROPS (IN AFRIKAANS),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker, N. Van Vliet, and H. W. Molenaar.
Water SA, Vol 7, No 4, p 255-264, October, 1981. 6 Fig, 7 Tab, 13 Ref.

Descriptors: *Water table rise, *Irrigation effects, *Saline soils, Crop yield, Drainage, Conductivity, Water pollution effects, Soil water, *Vaalharts Irrigation Project, *South Africa, Soil compaction, Soil density, *Saline water intrusion.

Overirrigation and leakage from soil dams produced a shallow groundwater table of 0.9-1.5 m at the Vaalharts Irrigation Scheme, South Africa. The water table rose further to 0.3-0.6 m from the surface during above average rainfall on occasions during 1974-1976, allowing salt accumulation and reducing yields of wheat, cotton, maize, and groundnuts to nearly zero. There was a correlation between electrical conductivity of the topsoil and wheat yield. Factors having a detrimental influence on seed germination and seedling growth were sodium absorption ratio less than 4, high bulk density, and high soil moisture content. The soil characteristics were a result of mechanical cultivation of the fine sandy soil and the shallow ground water table. Irrigation practices should be improved and drains installed if necessary. (Cassar-FRC)
W82-04359

EFFECT OF SURFACE SEALING ON INFILTRATION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. D. Moore.
Transactions of the ASAE, Vol 24, No 6, p 1546-1552, 1561, November/December, 1981. 6 Fig, 8 Tab, 40 Ref.

Descriptors: *Infiltration, *Surface sealing, *Soil water, Surface permeability, Soil types, *Model

studies, Richards equation, Ponding, *Soil properties.

Numerical solutions of Richards' equation showed the effects of surface sealing of soils on infiltration. The three conditions examined in the model were: (1) no seal, (2) developing seal, gradual surface sealing under rainfall activity, and (3) constant seal, a well-established surface seal. Rainfall application rate was 5.3 cm per hour. Measurements on nine A-horizon soils from different counties in Minnesota and Wisconsin were used as model inputs. Results indicated that surface sealing, virtually ignored in infiltration modeling in the past, reduced predicted infiltration rates and volumes by up to 80%. This may account for some of the differences in infiltration behavior observed by different researchers using the same soil type. (Cassar-FRC)
W82-04362

DEEP TILLAGE OF IRRIGATED PULLMAN CLAY LOAM--A LONG-TERM EVALUATION,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
J. T. Musick, D. A. Dusek, and A. D. Schneider.
Transactions of the ASAE, Vol 24, No 6, p 1515-1519, November/December, 1981. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Irrigation efficiency, *Cultivation, *Infiltration, Drainage, Furrow irrigation, Corn, Wheat, *Crop yield, Sorghum, Grain crops, Soil compaction, Soil density, Agriculture, Water stress, Bushland, Texas, Soil-water-plant relationships.

One-time deep moldboard plowing in 1966 to depths of 0.4, 0.6, and 0.8 meters in slowly permeable Pullman clay loam at Bushland, Texas, increased water intake and crop yield (wheat, sorghum, and corn) during subsequent years. This study reports the results of evaluations in the 1973-79 interval. Soil was disturbed by the deep plowing, which mixed some of the topsoil with lower layers so that the soil had a crumb-type structure, compared with the previous blocky peds. Compared with 0.2 m conventional tillage, the one-time deep tillage increased irrigation water uptake from 120 to 240 mm in 1975 and from 170 to 280 mm in 1978. This effect did not diminish with time. As soil compacted during the growing season from wheel traffic and irrigation water, the water permeability decreased. This was restored by conventional moldboard plowing to 0.2 m. The deep tillage treatment increased sorghum grain yields (in kg per ha) from 6040 to 7290 in 1975 and 9080 to 9960 in 1979. Similarly, corn yields (in kg per ha) were increased from 10,020 to 11,300 in 1977. The increased water intake and the deeper profile wetting of the deeply plowed fields delayed the beginning and reduced the severity of plant water stress. The deep-tillage method is most effective in the normally drier, lower parts of graded furrow irrigated fields, where tailwater runoff can be reduced. It is not recommended for upper sections of the field, where drainage losses may result. (Cassar-FRC)
W82-04372

INFILTRATION INTO TWO-LAYERED SOIL PROFILES,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. D. Moore, and J. D. Eigel.
Transactions of the ASAE, Vol 24, No 6, p 1496-1503, November/December, 1981. 7 Fig, 5 Tab, 34 Ref.

Descriptors: *Infiltration, *Soil profiles, *Ponding, *Soil water, Model studies, Soil porosity, Green-Ampt Mein-Larson model, Richards equation, Numerical analysis, Loam, Stratification.

Results from the Modified Green-Ampt, Mein-Larson infiltration equations (GAML) for two-layered soil profiles were compared with observed data and results from the numerical solution of Richards' equation. Examples of two-layered soil profiles are plowed soil over undisturbed soil and topsoil over mine spoil. The two-layers of soil used were a Lewiston fine sandy loam (coarse) and a Millville silt loam (fine). Both coarse-over-fine and fine-over-coarse were examined. In the two-layered soil profiles the GAML and numerical models produced similar results (time to surface ponding, infiltration volume, and infiltration rate). Layering sequence was a significant factor in infiltration behavior. Infiltration rates and volumes were lower for fine-over-coarse than for coarse-over-fine stratifications. For the coarse-over-fine profiles there was a general increase in time to ponding as the application rate decreased and surface layer thickness increased. For the fine-over-coarse, layering times to surface ponding predicted by the Modified GAML model were independent of the thickness of the surface layer. However, the time to ponding increased with increasing thickness for the numerical model. Agreement between predicted and observed data ranged from excellent to fair. Best agreement was for the smaller surface layer thicknesses. Both models underpredicted infiltration rates for coarse-over-fine stratifications. (Cassar-FRC)
W82-04536

NOTE ON PUDDLING EFFECTS ON WATER FLOW THROUGH SOILS,
Punjab Agricultural Univ., Ludhiana (India).
B. K. Sinha, S. R. Singh, and R. G. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 6, p 460-461, June, 1981. 1 Fig, 3 Ref.

Descriptors: *Irrigation practices, *Puddling, Percolation, Crop yield, *Rice, Irrigation requirements, Water loss, *Soil water.

The effect of puddling intensity on the nature of water flow and irrigation requirements of rice crop were investigated in laboratory and field studies. The response to puddling in different soils varied according to the soil texture. The resistance to water flow, as evidence by specific discharge, was increased in all the soils following puddling. The reduction in specific discharge after the first puddling ranged from 6 to 10 fold at different hydraulic gradients in sand. In sandy loam it was small, especially at lower gradients. In silty clay loam soil the reduction was marginal. Apparently puddling could reduce percolation losses only in coarse-textured soils. The second puddling was less effective than the first in reducing the specific discharge, except in sandy loam soil, where the second puddling might have resulted in a more uniform sealing of pores. Thus structure destruction due to puddling may not be of much importance in reducing water flux through the soil. Puddling altered the nature of water flow, particularly in silty clay loam. Increased puddling intensity in fine textured soils did not effect any significant saving in irrigation water. Evidently fine textured soils need not be puddled if the sole aim is to reduce percolation losses. (Baker-FRC)
W82-04671

WATER MOVEMENT IN UNIFORM SOILS DURING CONSTANT-FLUX INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra City (Australia). Div. of Environmental Mechanics.
K. M. Perroux, D. E. Smiles, and I. White.
Soil Science Society of America Journal, Vol 45, No 2, p 237-240, March/April, 1981. 5 Fig, 11 Ref.

Descriptors: *Infiltration, *Soil water, Mathematical models, Mathematical equations, Fluctuations, Absorption, Gravity studies, Ponding, *Soil water movement.

Several studies have addressed the problem of predicting water movement and distribution in soils during nonponding rainfall or sprinkler irrigation. While a variety of numerical methods have been successfully applied to flux boundary conditions for a variety of initial conditions, the search for general analytical solutions to the flow equation for the constant-flux boundary condition initially met with less success. This paper presents an analysis for constant-flux infiltration of water in soil based on the flux-concentration relation. The results of laboratory experiments on constant-flux infiltration into columns of fine sand and silty loam are compared with behavior predicted both with and without a gravitational component. The effect of gravity was shown to be small for the early stage. During the early stage it is possible to make sufficiently accurate predictions of moisture profile development using the simpler absorption analysis of White, et al. (1979). (Carroll-FRC)
W82-04691

2H. Lakes

ESTIMATION OF PRIMARY PRODUCTIVITY IN AQUATIC SYSTEMS USING FREE OXYGEN MEASUREMENTS,
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
R. Lingeman, and S. Vermij.
Water Resources Bulletin, Vol 16, No 4, p 745-748, August, 1980. 2 Fig, 13 Ref.

Descriptors: *Primary productivity, *Oxygen, *Temperature, Lakes, Productivity, Water temperature, *Model studies, Stratification, Heat transfer, Eddy diffusion, Barlosche Kolk, Netherlands.

One-dimensional models for heat or oxygen transport in aquatic systems have been used by several authors to estimate primary productivity. These methods use free oxygen and temperature measurements at discrete time and depth intervals and assume that the eddy diffusion coefficients of heat and oxygen are interchangeable. This method was applied to data from the Barlosche Kolk, a 3.5 ha lake with maximum depth of 6 m. Steep oxygen gradients and moderate temperature stratification are present in summer, but there is no distinct hypolimnion. Temperature and oxygen were measured hourly at 0.5 m intervals of depth. Primary productivity calculated from these data and the model did not agree with simultaneous measurements of primary productivity by the light and dark bottle method. It was concluded that the one-dimensional model is inadequate for this application because the discrete measurements of temperature and oxygen do not provide sufficient data. A more adequate model should include horizontal transports induced by internal waves along the sheets of steep temperature gradients. Continuous recording of temperature and oxygen may provide necessary data. (Cassar-FRC)
W82-04256

WATER BUDGET COMPUTATIONS FOR A SHALLOW--LAKE OKEECHOBEE, FLORIDA,
Florida Univ., Belle Glade. Agricultural Research and Education Center.
S. F. Shih.
Water Resources Bulletin, Vol 16, No 4, p 724-728, August, 1980. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Hydrologic budget, *Storage capacity, *Evapotranspiration, Lakes, *Lake Okeechobee, *Florida, Shallow lakes, Marsh plants, Model studies, Evaporation.

The water budget for Lake Okeechobee, Florida, was computed using a model which included marsh plant evapotranspiration. This model was labeled WET and the conventional methods, without the evapotranspiration factor, WOET. Three periods were used to compare the differences in the sum of storage deviation between the two methods. These periods differed in length: testing (1969-74), planning (1963-74), and recorded period (1952-77). The WOET method gave the following sums of stage deviations: 87.42 cm, 231.80 cm, and 284.5 cm for the three periods respectively. These were equivalent to 29, 76, and 93% of the lake volume. The WOET method overestimated storage, as compared with recorded data, for 21 out of 26 years. The WET method reduced the sum of storage deviation by 42, 31, and 49%, respectively, for the three periods. The sums of stage deviations were 50.72 cm, 160. 08 cm, and 144.81 cm, respectively. Storage deviations were overestimated in 15 out of 26 years. (Cassar-FRC)
W82-04258

PHOSPHORUS AVAILABILITY IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,

McGill Univ., Montreal (Quebec). Dept. of Biology.
R. H. Peters.
Limnology and Oceanography, Vol 26, No 6, p 1150-1161, 1981. 4 Fig, 3 Tab, 40 Ref.

Descriptors: *Lakes, *Phosphorous, Nutrients, Biomass, *Lake Memphremagog, Canada, Rivers, Limnology, Water analysis.

Water samples were taken from Lake Memphremagog and five of its tributaries. The percentage of total phosphorus in the samples which was biologically available was measured on three dates. The criteria used to measure the percentage of biologically available phosphorus were the distribution of radioactive phosphorus among exchanging fractions and the enzymatic release of soluble phosphorus from particulate phosphorus when stored with chloroform. The available phosphorous in the lake water formed 83% of the total phosphorus. The available phosphorous in rivers was only 18-57% of the total, much less than in the lakes. The most refractory fraction was usually high molecular weight phosphorus, and was separated by gel filtration. Substantial amounts of unavailable phosphorus were also associated with particles and with low molecular weights. Intermediate molecular weight soluble phosphorus was too small a fraction for determining its availability. Variations in the percentage of available phosphorus in natural waters could substantially change the biological effect of a given phosphorus load. (Baker-FRC)
W82-04324

COMPARISONS OF SOLUBLE REACTIVE PHOSPHORUS AND ORTHOPHOSPHORUS CONCENTRATIONS AT AN OFFSHORE STATION IN SOUTHERN LAKE MICHIGAN,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, and C. Rubitschun.
Journal of Great Lakes Research, Vol 7, No 3, p 290-298, 1981. 2 Fig, 3 Tab, 32 Ref.

Descriptors: *Phosphorus, *Lake Michigan, Lakes, Phosphates, Bioassay, Chemical analysis, *Fate of pollutants, Pollutant identification, Lake sediments, Phytoplankton.

Soluble reactive phosphorus in the epilimnion of southeast Lake Michigan, measured at a station 15 km from shore in May-October 1976, was higher and more variable than previously published measurements. The overall means were 4.9 micrograms P per liter (range 2.0-10.3 micrograms P per liter) using Harvey's method and 3.4 micrograms P per iter (range 1.2-7.7 micrograms P per liter) using the Chamberlain-Shapiro extraction technique. At times there were significant vertical variations in the water column and near the sediment, but the hypolimnion did not accumulate P. Both methods overestimated maximum possible phosphate-P concentrations up to two orders of magnitude. Maximum possible phosphate-P concentrations as measured by Rigler's radiobioassay method were an average of 22.5% of those measured by Harvey's method and 25.6% of those measured by the extraction technique. Several factors which could cause too-high P measurements were investigated. It was concluded that the values were, in fact, higher because high concentrations of particulates were carried out to distances 10-15 km from shore in this region during the extremely wet year 1976. Data suggest that true phosphate concentrations may be lower in the epilimnion of eutrophic lakes than in mesotrophic lakes because of high biological utilization rates and less efficient recycling mechanisms. (Cassar-FRC)
W82-04377

TEMPERATURES AND CURRENTS IN A STRATIFIED LAKE: A TWO-DIMENSIONAL ANALYSIS,

Arizona Univ., Tucson.
J. Henrich, W. Lick, and J. Paul.
Journal of Great Lakes Research, Vol 7, No 3, p 264-275, 1981. 13 Fig, 36 Ref.

Descriptors: *Water temperature, *Water currents, *Stratification, Lakes, Water circulation, Lake circulation, Temperature, Currents, Wind-driven currents, Thermal stratification, *Lake Erie, *Model studies, Thermocline, Turbulent flow, Heat transfer.

A two-dimensional (vertical and horizontal) time-dependent model was used to predict temperatures and currents in a stratified lake comparable to the central basin of Lake Erie. Stratified flow during the time of formation, maintenance, and decay of the thermocline were investigated. Increasing heat flux to the water causes earlier, shallower, and stronger formation of a thermocline. Increasing turbulence causes later, deeper, and weaker thermocline formation. Heat transfer to the sediment in a shallow lake can decrease hypolimnion temperatures by 1 C. Effects of a sinusoidal 24-hour period heat flux and the temperature distribution of thermal radiation are limited to the near surface region and do not change thermocline formation. Wind stress perpendicular to the cross-section results in a stronger, narrower return flow just above the thermocline than does wind parallel to the cross-section. Wind reversal shifts the orientation of the thermocline so that the hypolimnion waters are shifted in the upwind direction and the thermocline becomes deeper in the downwind direction. If wind has not reversed by 50 days, a second thermocline can form above the first thermocline. In general, calculated results agreed with observations. (Cassar-FRC)
W82-04378

WINTER TEMPERATURE STRUCTURE IN LAKE HURON,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. S. Miller, and J. H. Saylor.
Journal of Great Lakes Research, Vol 7, No 3, p 201-206, 1981. 8 Fig, 1 Tab, 13 Ref.

Descriptors: *Water temperature, Stratification, *Mixing, Lakes, *Lake Huron, Temperature, Water depth, *Thermal stratification, Water circulation, Seasonal variation.

Water temperatures were continuously recorded at 17 sites in Lake Huron during the winter of 1974-75 at depths of 15,25, and 50 m below the surface and 2 m from the bottom. In the beginning of fall overturn in November several warm pulses were observed at depths below 100 m. The shallower southern basin was already isothermal at 7 C. Monthly isotherms followed the bathymetry of the lake. The shore regions rapidly cooled to near freezing by early February. The deep northern basin did not reach a minimum of 1.5 C until mid-April. Differences between mean monthly temperatures at the 15 and 25 m depths were < 0.3 C during December-April. In the deep basins a weak winter thermocline, temperature difference 1.5 C, developed in March and nearly disappeared by April. (Cassar-FRC)
W82-04381

FACTORS REGULATING THE SPATIAL DISTRIBUTION OF THE FILAMENTOUS ALGA PITHOPHORA OEDOGONIA (CHLOROPHYCEAE) IN AN INDIANA LAKE,

Purdue Univ., Lafayette, IN. Dept. of Botany and Plant Pathology.
D. F. Spencer, and C. A. Lembi.
Journal of Phycology, Vol 17, No 2, p 168-173, 1981. 8 Fig, 4 Tab, 26 Ref.

Descriptors: *Algal growth, *Lakes, Littoral environment, Littoral zone, Algae, Eutrophication, Nitrogen, Phosphorus, *Nutrients, Limiting factors, Limiting nutrients.

A combined field and laboratory study was designed to determine the factors regulating the spatial distribution of Pithophora oedogonia in Surrey Lake, Indiana. Surrey Lake is small and shallow, man-made, with a water flow from south to north. The inflowing stream drains a watershed of about 1128 ha, 62% of which is agricultural land and pastures, 21% woodland, and 16% residential properties. Water samples and algal biomass samples were collected from May 1978 to December 1979. The biomass was greater in the littoral than in the pelagial region. Although mean soluble reactive phosphorus concentrations did not differ significantly in the open vs cove water, nitrate concentrations were almost six times higher in the latter. Nitrogen limiting conditions were prevalent in the open water section of the lake. Alkaline phosphatase and dark ammonia uptake analyses on field collected filaments from the shallow and deep water sections confirmed the hypothesis that nitrate is the major factor limiting growth of Pithophora in Surrey Lake. (Baker-FRC)
W82-04382

ULTRAPLANKTON BIOMASS, PRODUCTIVITY AND EFFICIENCY IN LAC MATAMEC, A PRECAMBRIAN SHIELD LAKE,

Waterloo Univ., (Ontario). Dept. of Biology.
P. E. Ross, and H. C. Duthie.
Journal of Phycology, Vol 17, No 2, p 181-186, 1981. 5 Fig, 3 Tab, 44 Ref.

Descriptors: *Lakes, *Plankton, Aquatic life, Phytoplankton, Biomass, Photosynthesis, *Canada, Eutrophication, *Lake Matamec, Aquatic productivity, Oligotrophic lakes, *Quebec.

Extremely low phosphorus concentrations were found in Lac Matamec, suggesting that it must be extremely oligotrophic. The summer range of chlorophyll concentrations places the lake among the least productive in the world. Since blue light is attenuated most quickly with depth and red light the least, a characteristic typical of water rich in dissolved humic substances, the lake may also be dystrophic. Further evidence for a dystrophic condition lies in the relationship between chlorophyll a and light extinction. In Lac Matamec there is virtually no correlation between the two parameters of chlorophyll and transparency. The ultraplankton accounted for an average of 47% of the biomass of the lake, but yet was responsible for 71% of the carbon fixation. The ultraplankton had the highest photosynthetic efficiencies of the three classes, ultraplankton, nanoplankton, and plankton. The importance of the ultraplankton in the ecology of Lac Matamec is enhanced by the marked scarcity of littoral habitat. High surface:volume ratios may explain the high efficiency of the ultraplankton. (Baker-FRC)
W82-04383

SUNLIGHT INDUCED MOVEMENT OF PLANKTONIC ORGANISMS AND THEIR RELATIONSHIPS TO WATER MOVEMENTS,

Kentucky Water Resources Research Inst., Lexington.
J. Calkins, E. Wallingford, and C. Hulsey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211509, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 132, 1982. 59 p, 12 Fig, 1 Tab, 32 Ref. OWRT A-082-KY(1). 14-340001-0119(FY80), 14-34-0001-1119(FY81).

Descriptors: Ecosystems, *Ultraviolet radiation, Ozone, Microorganisms, Thermocline, *Solar radiation, *Plankton, Plankton-sunlight-water movement relationships, Radiation regime, UV-B.

Previous studies have shown the planktonic organisms of various natural water bodies to be quite sensitive to the levels of solar ultraviolet radiation incident at the water surface in summer. It has been assumed that the majority of the phytoplankton are simply carried about in the mass of the water which they inhabit with little controlof their position or sunlight exposure. Photosynthetic microorganisms must strike a delicate balance with regard to solar radiation; they must obtain enough visible light for adequate photosynthesis while avoiding an excessive exposure to the injurious solar UV-B radiation. It is proposed that the circulation in natural waters is such that organisms can 'ride' the current to obtain radiation exposures approximating the average radiation level of the euphotic zone. If exposure tends to become excessive, the plankton 'drop out' of the circulation into the relatively immobile thermocline region until conditionss are favorable for a return to the highly illuminated surface waters. Observations with two

species of aquatic plants generally cofirm the proposed model. A radiation regime where the entire population receives essentially the same exposure to sunlight could be substantially more efficient in using the available light for photosynthesis than the 'static' model where it is assumed that part of the population is overly exposed and another segment continuosly dwells deep in the water in very dim light.
W82-04417

SECULAR CHANGES IN ANNUAL AND SEASONAL GREAT LAKES PRECIPITATION, 1854-1979, AND THEIR IMPLICATIONS FOR GREAT LAKES WATER RESOURCE STUDIES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab. MI.
For primary bibliographic entry see Field 2B.
W82-04431

RIDGE REGRESSION TECHNIQUES APPLIED TO LANDSAT INVESTIGATION OF WATER QUALITY IN LAKE OKEECHOBEE,
Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
S. F. Shih, and J. C. Gervin.
Water Resources Bulletin, Vol 16, No 5, p 790-796, October, 1980. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Eutrophic lakes, *Water quality, Light penetration, Regression analysis, Lakes, Mathematical studies, *Turbidity, Water analysis, Opacity, Eutrophication, *Chlorophyll a, *Suspended sediments, Remote sensing, *Landsat, *Lake Okeechobee, Florida.

Studies were made on the eutrophic Lake Okeechobee in Florida to derive a relationship between the chlorophyll a, turbidity and suspended sediment water quality parameters and Landsat radiance values applicable over several days and to compare the regression results for two different levels of accuracy in measuring Landsat radiance values. The general concepts of ridge regression techniques were applied to satellite data analysis. Landsat radiance values processed at a double level of precision gave a better solution when applied to the estimation of water quality parameters. Ridge regression analysis for double level accuracy eliminated problems of multicollinearity and reduced the total mean square error by 13 to 20% and the confidence interval by 6 to 28% when compared to ordinary least square analysis. The stabilized regression equations and individual parameter estimates are more readily interpretable from the standpoint of lake water quality analysis. (Geiger-FRC)
W82-04440

EFFECT OF TEMPERATURE ON HETEROTROPHIC GLUCOSE UPTAKE, MINERALIZATION, AND TURNOVER RATES IN LAKE SEDIMENTS,
Orange Free State Univ., Bloemfontein (South Africa). Inst. for Environmental Sciences.
D. F. Toerien, and B. Cavari.
Applied and Environmental Microbiology, Vol 43, No 1, p 1-5, 1982. 6 Tab, 18 Ref.

Descriptors: *Glucose, *Bottom sediments, *Lakes, Sedimentation, Chemical analysis, Absorption, Metabolism, Mineralization, *Lake Kinneret, *Israel, *Temperature effects, Microbial degradation.

Using sediments from Lake Kinneret, Israel, an evaluation was made of the effect of temperature on the maximum uptake rate, in situ substrate concentration and turnover rate for glucose uptake and mineralization. The major features of Lake Kinneret sediments are a high percentage of fine grain material, an abundance of calcium carbonate, and a dominance of montmorillonite in the clay fraction. The maximum uptake rate was similar when aerobic and anaerobic conditions were used in the assay procedure. The maximum uptake rate values for carbon dioxide evolution (glucose mineralization) ranged from 2.75 to 4.77 micrograms of CO2/g/hr. No consistent pattern was observed in glucose mineralization for the aerobic or anaerobic sediments when assayed aerobically or anaerobically. All temperature experiments were run under aerobic conditions. It was concluded that the maximum uptake rate and the turnover rates of glucose uptake and mineralization were temperature dependent. The glucose respiration/uptake ratio was not greatly influenced by the presence or absence of oxygen or by different assay temperatures. (Baker-FRC)
W82-04466

CONTRIBUTION OF PARTICLE-BOUND BACTERIA TO TOTAL MICROHETEROTROPHIC ACTIVITY IN FIVE PONDS AND TWO MARSHES,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
D. Kirchman, and R. Mitchell.
Applied and Environmental Microbiology, Vol 43, No 1, p 200-209, 1982. 2 Fig, 5 Tab, 46 Ref.

Descriptors: *Ponds, *Bacteria, *Marshes, Ecosystems, Biomass, Particulate matter, Microbiological studies, Coastal mareshes, Salinity, Filtration, Metabolism, Organic compounds, *Coastal waters.

This report compares the number and heterotrophic activity of epibacteria and unattached bacteria in five coastal ponds and two marshes. It is suggested that, although the numbers of epibacteria are low, they may contribute significantly to the turnover of dissolved organic matter in selected aquatic ecosystems. The data presented support the hypothesis that bacteria associated with particulate matter are metabolically more active per cell than unattached bacteria. The particle-bound bacteria incorporated a large proportion of glucose and glutamate in selected aquatic systems. The uptake per cell was significantly higher for epibacteria than for unattached bacteria in all systems. Particle-bound bacteria were more important than total bacteria in those waters with a high particle concentration and not flushed regularly by tides in contrast to waters with a low particle concentration and being flushed regularly. The study indicates that the importance of epibacteria may be greatly underestimated due to their small numbers. (Baker-FRC)
W82-04467

HORIZONTAL DISTRIBUTION AND FLUX OF PHOSPHORUS IN FISH LAKE, WISCONSIN,
Wisconsin Univ.-Madison.
R. J. Erickson.
PhD Thesis, August, 1980. 189 p, 13 Fig, 19 Tab, 110 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28177.

Descriptors: *Lakes, *Littoral environment, *Phosphorus, Sediments, Mass transfer, *Fish Lake, *Distribution patterns, *Wisconsin, Pelagial sources.

Effects of the littoral zone on epilimnetic phosphorus were investigated in Fish Lake, Wisconsin, a mesoeutrophic, calcareous, seepage lake with an area of 88 ha, maximum depth of 19 m, and mean depth of 6.3 m. The littoral comprises 55% of the lake's area and is diverse with respect to sediment texture, angiosperm development, and hydraulic turnover time with the pelagial. Phosphorus concentrations were positively correlated with areas with (a) fine sediment and significant angiosperm development, (b) limited exchange of water with the pelagial, and (c) substantial runoff contributions to sediments. During turnover, pelagial phosphorus concentrations equalled or exceeded littoral concentrations because the hypolimnetic phosphorus pool became a significant phosphorus source to surface waters. Littoral phorphorus concentrations were not correlated with groundwater seepage and showed only a minor response to surface runoff events. This suggests that internal loading from littoral sediments was the major cause of these gradients rather than temporary storage of external loadings. The existence of internal loading was confirmed by observations of phosphorus accretion in littoral enclosures. Littoral-to-pelagial transport was the major phosphorus source to the pelagial during summer stratification, corresponding to 300-1300% of the pelagial phosphorus pool. Net transport of phosphorus from the littoral requires a source of phosphorus to replenish littoral sediments. Measurements in this investigation suggested that external loading was a major immediate source of this phosphorus, but that return of phosphorus from midlake to the littoral during turnover could also be important. (Sinha-OEIS)
W82-04484

HEAVY METAL CONTENT IN SEDIMENTS OF LAKES IN SOUTHERN BAVARIA AS A SIGN OF LONG-TERM ENVIRONMENTAL IMPACT (SCHWERMETALLGEHALTE IN SEDIMENTEN SUDBAYERISCHER SEEN ALS INDIKATOREN LANGFRISTIGER UMWELTBELASTUNG),
Munich Univ. (Germany, F.R.). Geographisches Inst.
For primary bibliographic entry see Field 5B.
W82-04550

SIMULATION AND VERIFICATION OF LAKE ONTARIO'S MEAN STATE,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. C. K. Huang, and P. W. Sloss.
Journal of Physical Oceanography, Vol 11, No 11, p 1548-1566, November, 1981. 11 Fig, 2 Tab, 35 Ref.

Descriptors: *Model studies, *Lakes, Thermal stratification, Stratification, *Lake Ontario, Great Lakes, Flow pattern, Wind, Mathematical studies, *Limnology.

A numerical dynamic model was developed for Lake Ontario based on primitive equations. All major current generating mechanisms were taken into account. The model is used for hindcasting the mean state in Lake Ontario during the International Field Year for the Great Lakes (IFYGL). Two simulations were carried out in July and December as representations of summer and winter. One simulation was done under the respective monthly mean steady frocing and the other under the respective hourly, time dependent atmospheric forcing. The constant forcing simulation resulted in a typical two gyre circulation pattern when the wind blew approximately parallel to the major axis of the lake. In the time dependent variable forcing simulation, the high frequency atmosheric fluctuations have not only excited strong inertial motions, but also generated mesoscale eddied near the downwind end boundary. Large scale low frequency topographic waves, propagating cyclonically at a phase speed of 60 cm/second, are also shown in the simulations. the generation, evolution, and dissipation of topographic waves, as well as mesoscale eddies can be expalined satisfactorily by the principle of conservation of potential vorticity. In the July case the lake dynamics are more complicated owing to the presence of thermal stratifications in addition to the mechanical forcing. (Baker-FRC)
W82-04570

STRUCTURE OF THE FLOW WITHIN THE COASTAL BOUNDARY LAYER OF THE GREAT LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
C. R. Murthy, and D. S. Dunbar.
Journal of Physical Oceanography, Vol 11, No 11, p 1567-1577, November, 1981. 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Boundary layers, *Lakes, Lake Huron, Boundaries, *Great Lakes, Lake coasts, Flow patterns, Flow, Coastal waters, Nearshore processes, Water currents.

Detailed observations on properties of the nearshore flow were noted at Douglas Point, Lake Huron. A network of current meters deployed in a coastal chain perpendicular to the local shoreline was used to obtain time series flow data. Data from these points was analyzed to resolve the mean flow

properties, horizontal turbulence characteristics and the kinetic energy within the coastal boundary layer. The variability of these parameters as a function of the distance from shore for an episode during which persistent short-parallel currents prevailed for several days has revealed two distinct boundary layers, an inner boundary layer dominated by bottom and shore friction and an outer boundary layer as a consequence of the adjustments of inertial oscillations to the lateral boundary. If the width of the frictional boundary layer is taken as the distance to the point where the kinetic energy of currents peak, it is about 2 km at Douglas Point. As the width of the inertial boundary layer, the distance to the point where inertial oscillations begin to dominate short parallel flow may be taken. This width at Douglas Point is about 8 to 10 km. (Baker-FRC)
W82-04572

WIND MIXING AND RESTRATIFICATION IN A LAKE NEAR THE TEMPERATURE OF MAXIMUM DENSITY,
Department of the Environment, Victoria (British Columbia). Inst. of Ocean Sciences.
D. M. Farmer, and E. Carmack.
Journal of Physical Oceanography, Vol 11, No 11, p 1516-1533, November, 1981. 13 fig, 2 Tab, 34 Ref.

Descriptors: *Thermal stratification, *Wind, Mixing, Density, *Destratification, *Lakes, Temperature effects, Seasonal variation, Convection, Babine Lake, *British Columbia, Canada.

Wind mixing and restratification were studied under conditions of a density maximum during the cooling of a freshwater lake. A mixed layer model was used to explore the concepts. The model incorporated both nonlinearity and pressure dependence in the equation of state. The results offer a basis for interpreting temperature structure in Babine Lake and for making some more general observations on mixing and restratification. After summer stratification is destroyed by wind mixing and convection in autumn, the lake is essentially isothermal as it cools through 4 degrees C. The coefficient of expansion becomes so small near this temperature that pressure effects which play little part in the dynamics at higher temperatures can dominate the stability. The transition between forced and free convection is marked at the depth where the local temperature equals the temperature of maximum density at constant pressure. Above this transition depth the wind must work against buoyance forces during cooling. Below this temperature the water is gravitionally unstable. Conditional instabilities occur which allow for a downward movement of initially stable water, leading to gravitational instability. As the lake cools the stability becomes less sensitive to pressure, and a given heat flux produces a progressively greater buoyancy flux, leading to the process of restratification. (Baker-FRC)
W82-04573

DETERMINATION OF CHARACTERISTIC VALUES FOR PHYSICAL AND CHEMICAL LAKE SEDIMENT PARAMETERS,
National Swedish Environment Protection Board, Uppsala (Sweden).
L. Hakanson.
Water Resources Research, Vol 17, No 6, p 1625-1640, December, 1981. 20 Fig, 13 Tab, 31 Ref.

Descriptors: *Sediments, *Lake sediments, *Physical properties, *Path of pollutants, Lakes, Mercury, Organic matter, Nitrogen, Phosphorus, Zinc, Heavy metals, Metals, Nutrients, Model studies, Characteristic values, Statistical analysis, *Sweden.

Characteristic values are determined for physical and chemical sediment parameters in lakes. The various physical sediment parameters (water content, bulk density, organic content, grain siize, degree of compaction, and sediment depth) are related to each other and to the sediment water conoent, a key parameter. The areal distribution of these physical parameters is described by a general formula, which is used with data for 5 Swedish lakes (Hjalmaren, Vanern, northern Vattern, western Malaren, and Ekoln). This relationship provides a way to determine the physically relevant characteristic values, not just traditional statistical values. Results show that (1) the distribution of the physical sediment parameters depends on the water depth, (2) the standard deviation around the mean is large in shallow waters where erosion, transportation, and fine sediments occur, (3) the spread decreases with increasing water depth, and (4) the spread is relatively small at water depths within the zone of accumulation. A formula is given for estimating the critical water content separating areas of accumulation from zones of transportation. Characteristic values may also be determined for chemical parameters showing high correlation with water content (the noncontaminating parameters). This procedure cannot be used on pollutants, which are usually distributed as distinct tongues with concentrations decreasing with increasing distance from the pollution source. Characteristic values for contaminating substances such as mercury may be determined from a map showing the areal distribution pattern as the areal median value. (Cassar-FRC)
W82-04586

BIOGENIC CALCITE STRUCTURES FORMING IN LAKE FRYXELL, ANTARCTICA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. A. Wharton, Jr., B. C. Parker, G. M. Simmons, Jr., K. G. Seaburg, and F. G. Love.
Nature (London), Vol 295, No 5848, p 403-405, February 4, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Polar regions, *Lakes, Calcite, *Lake Fryxell, *Antarctic, Precambrian era, Microorganisms, Sedimentation, Algal growth, Inflow, Meltwater.

Observations in Lake Fryxell, Antarctica, revealed biogenic calcite structures not observed in other studies of Antarctic lakes. These structures were laminated, indurate, unbranched, and had either a vertical or a horizontal orientation. It was inferred that these calcite structures are biogenic in origin, due to the presence of an actively metabolizing algal mat on their surface and an internal composition of filamentous blue-green algal cell wall fragments, diatom frustules and calcite crystals. Lake Fryxell is located at the eastern end of Taylor Valley in southern Victoria Land. The lake lacks outgoing streams, and receives sediment, salts and nutrients from glacial meltstreams during the austral summer. The vertical calcite structures in the lake apparently resulted from the growth of the algal mat in dimly-lit shallow, non-turbulent water. Further study may offer insight into the palaeoecology of Precambrian stromatolites. (Baker-FRC)
W82-04638

PREDICTION OF THE CIRCULATION IN RESERVOIRS,
Liverpool Univ. (England). Dept. of Civil Engineering.
K. H. M. Ali, and D. Pateman.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 427-461, June, 1981. 27 Fig, 20 Ref.

Descriptors: *Reservoirs, *Water circulation, *Wind-driven currents, Lake circulation, *Model studies, Water currents, Coriolis force, Shallow lakes.

Circulation in shallow, open reservoirs was analyzed analytically and experimentally. The theoretical work considered inflows and outflows and geostrophic and wind effects. Experimental work was done on three circular reservoirs with radii of 0.73 to 3.68 m, using dye and illuminated surface floats. In a circular reservoir tangential or radial jets caused circulation patterns dependent on the Reynolds number of the jet and the aspect ratio of the reservoir. Outlet dimensions had little influence on circulation patterns. Circulation was predicted for prototype reservoirs using the equations developed in this paper. Water circulation caused by wind and the earth's rotation were highly dependent on reservoir water depth, wind shear stress at the water surface, and eddy viscosity. Predicted circulation was not applicable to the peripheral areas of the reservoirs. Diagrams for circulation in the experimental reservoirs are given for different combinations of wind stress, eddy viscosity, Coriolis factor, jet velocity, and water depth. (Circulation patterns for two irregularly-shaped reservoirs at Liverpool are also given. (Cassar-FRC)
W82-04682

LIMNOLOGICAL CHARACTERISTICS OF EUTROPHIC LAKE ISTOKPOGA, FLORIDA,
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
W. F. McDiffett.
Florida Scientist, Vol 44, No 3, p 172-181, 1981. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Eutrophication, *Limnology, Lakes, Nutrients, Phosphorus, Algal growth, *Lake Istokpoga, *Florida, Field studies, Path of pollutants, Primary productivity, Agricultural runoff, Watersheds.

The results of a comprehensive limnological investigation of Lake Istokpoga are described. This lake represents a significant component of the Lake Okeechobee drainage basin. Nutrient enrichment bioassay experiments are also discussed. The study area is located in Highlands County, south-central Florida, just east of the Lake Wales sand ridge. The surface area is about 112 square kilometers, with a drainage basin of about 1700 square kilometers. The physico-chemical data indicate a well mixed body of water. The large surface area in conjunction with a shallow depth facilitates wind-generated mixing. The influent streams are significant contributors of nutrients to the lake; high primary productivity levels are the result. Irrigation projects contribute significant amounts of nutrients in runoff during dry periods. Nutrient enrichment experiments indicated that primary productivity in the lake was chiefly limited by phosphorus. Seasonal differences in response to ambient algal populations may have been responsible. Taken as a whole, the data suggest that Lake Istokpoga is a eutrophic system. (Baker-FRC)
W82-04719

THE BIOGEOCHEMISTRY OF SULFUR IN TWO SMALL LAKES,
R. B. Cook.
PhD Thesis, 1981. 267 p, 46 Fig, 45 Tab, 97 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13497.

Descriptors: *Biochemistry, *Lakes, *Sulfur, Bacteria, Sediments, Alkalinity, Chemical reactions, Chemical reduction, Chemical model.

The sulfur cycle in natural systems is greatly influenced by the presence of anoxic zones in which sulfate may be bacterially reduced to form labile H2S. The two lakes examined in this study, Lake 227 and Lake 223 at the Experimental Lakes Area, northwestern Ontario, have seasonally anoxic hypolimnia that exhibit bacterial sulfate reduction. Sulfate reduction rates were estimated from the decrease in hypolimnion sulfate concentrations during thermal and winter stagnation for both lakes and from a water column numerical model in L227. The anoxic breakdown of organic matter, as indicated by NH3 production, liberates S from amino acids and proteins at a rate 1/3 that of sulfate reduction in L227 and 4% of sulfate reduction in L223. Comparison of predicted amounts of FeS precipitated with actually measured FeS shows that there is approximately 3 years accumulation in L223 and greater than 10 years in L227. In L223, all of the FeS that formed during the acidification experiment is present in the sediment. The residence times for sulfate in both lakes are similar to the water residence times (2-6 years). A chemical model has been derived which predicts the increase in alkalinity from ammonia production, sulfate reduction, Fe 2+ production and FeS precipitation and compares this to the observed increase in alkalinity. This model shows that alkalinity gained by Fe 2+ production and FeS precipitation and compares this to the observed increase in alkalinity. This model shows that alkalinity gained by Fe 2+ is lost from the lake system during the invasion of oxygen at fall overturn

when Fe 2+ precipitates as an iron(III) hydroxide. (Sinha-OEIS)
W82-04726

ADDITION OF RADIOCARBON TO THE MIXED-LAYERS OF TWO SMALL LAKES: PRIMARY PRODUCTION, GAS EXCHANGE, SEDIMENTATION AND CARBON BUDGET,
P. M. Bower.
PhD Thesis, 1981. 263 p, 49 Fig, 53 Tab, 104 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25254.

Descriptors: *Lakes, *Primary productivity, *Phytoplankton, *Sedimentation, *Carbon cycle, Photosynthesis, Carbon radioisotopes, Mixed layers, Dimictic lakes, Gas exchange.

Addition of radiocarbon to the mixed-layers of two small dimictic lakes had made it possible to assess the validity of enclosing natural phytoplankton populations in bottles for the purpose of estimating primary production. Productivity results for the incubator-model averaged from 0.77 to 0.93 of the whole-lake values depending upon the choice of variables as input to the model. During a period of very high productivity, the 16 hour in situ incubations underestimated the whole-lake results by an average 60%, but the performance of the incubator-model was not affected during this time. Strong surface inhibition of photosynthesis was observed in the vertical profiles of production for the 4 and 16 hour in situ incubations but it was never quantitatively significant for the incubator-model. It is argued that this strong surface depression of photosynthesis is an artifact of the stationary position of the bottles and the unnaturally long exposure to supraoptimal light. A correction for daytime respiration of C14 incorporated on previous days suggests that whole-lake productivity is significantly enhanced over that measured in bottles. The fate of C14 was also monitored in the dissolved inorganic, dissolved and particulate organic, and sediment organic fractions. (Sinha-OEIS)
W82-04730

DISTRIBUTION OF CLAY MINERALS AND THEIR DIAGENESIS IN THE SEDIMENTS OF LAKE EDKU,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 2J.
W82-04748

2I. Water In Plants

SUNFLOWER YIELD VS. WATER DEFICITS IN MAJOR GROWTH PERIODS,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
E. C. Stegman, and G. W. Lemert.
Transactions of the ASAE, Vol 24, No 6, p 1533-1538, 1545, November/December, 1981. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Water stress, *Evapotranspiration, *Irrigation requirements, *Sunflower, Seeds, Crop yield, Water requirements, Water use, *Growth stages, North Dakota, Root zone, Plant growth, Soil water.

Water stress was applied to several growth stages of sunflower (hybrid 894): planting to bud, bud to last anther, and last anther to physiologic maturity. Stress level, based on degree of soil water depletion and an allowable level of leaf xylem pressure depression in mid-afternoon, was generally limited to one of the three growth stages. Seed yields vs. seasonal evapotranspiration showed a linear relationship for the upper bound function near 84.3 kg per ha per cm. Maximum yields at two North Dakota sites were 2900 kg per ha (seasonal evapotranspiration, 47 cm) and 3400 kg per ha (seasonal evapotranspiration, 51 cm). On a relative scale the upper bound slope indicated a potential yield loss of 1.3% per 1.0% decline in seasonal evapotranspiration. In this climate near potential yield was attained when available root zone storage capacity was not less than 50-60% in the planting to bud period, 30-40% in the bud to last anther period, and 50-60% in the seed filling period. Reductions of 20% in water requirements are possible with appropriate irrigation regimes. (Cassar-FRC)
W82-04361

EFFECTS OF DECREASED WATERING ON CROP YIELDS,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. Sammis, and J. Guitar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211442, Price codes: A03 in paper copy, A01 in microfiche. WRRI Report No 36, August, 1981. 29 p, 3 Fig, 9 Tab, 23 Ref. OWRT-A-063-NMEX(1).

Descriptors: *Alfalfa, *Cotton, *Crop response, Sprinkler irrigation, Lysimeters, Consumptive use, Irrigation deficit, *New Mexico, *Soil-water-plant relationships, Water production function.

Cotton and alfalfa were irrigated for three years at Las Cruces, with a range of water levels using a sprinkler-line source to determine yield and evapotranspiration under deficit irrigation. Alfalfa was grown at five locations and cotton was grown at two locations in New Mexico using flood irrigated nonweighing lysimeters to measure the yield and evapotranspiration under nonlimiting soil-moisture conditions. A linear water-production function was observed for alfalfa. This function appeared to be transferable to any location in New Mexico, based on the data from five locations within the state. The New Mexico relationship was statistically the same as alfalfa water-production functions for Nebraska and North Dakota. A linear water-production function was also observed for cotton, but was applicable only for the two areas in southern New Mexico where the study was conducted. This study indicated that biomass production may require the same amount of evapotranspiration regardless of site and management differences, as in the case of alfalfa, but that lint or seed production per unit of water will vary from place to place and from year to year.
W82-04411

EFFECTS OF SOIL MOISTURE, PLANTING DATE, AND WEEDS ON CEREAL YIELDS (EFFETS DE L'HUMIDITE DU SOL, DES DATES DE SEMIS ET DES MAUVAISES HERBES SUR LE RENDEMENT DES CEREALES),
Department of Agriculture, Sainte-Foy (Quebec).
J. M. Deschenes, and J. P. Dubuc.
Canadian Journal of Plant Science, Vol 61, No 4, p 851-857, December, 1981. 4 Tab, 17 Ref. English summary.

Descriptors: *Irrigation effects, *Soil-water-plant relationships, *Planting management, *Crop yield, Grain crops, *Cereal crops, Wheat, Oats, Barley, Weeds, Plant growth, Soil temperature, *Quebec.

An observed increase in grain yield from early sowing was investigated using two seeding dates (early and late May), two soil moisture levels (natural precipitation and natural plus irrigation with 25 mm of water per week), and three crops (oats, barley, and wheat). Studies were conducted in the field and under greenhouse conditions in Quebec's St. Andre sandy loam during 1976, 1977, and 1979. In the field early seeding plus irrigation increased yields, but the difference in planting time was more significant than the difference in soil moisture levels. Irrigated, late-planted cereals produced 80% of the yield of unirrigated, early-planted cereals. More than 50% of the yield variation was explained by the soil thermal units between sowing and emergence and the total amount of water between emergence and heading. Greenhouse results were similar to field results except that the effect of soil moisture was more evident. Weeds did not play an important role. Best cereal yields in this climate and soil are obtained by cool soil temperatures at seeding and high soil moisture between emergence and heading. Early May sowing fulfills these conditions. (Cassar-FRC)
W82-04470

SORGHUM AND BARLEY IN SOUTHERN ALBERTA: GRAIN YIELD RESPONSE TO IRRIGATION AND FERTILIZER,
Department of Agriculture, Lethbridge (Alberta).
E. H. Hobbs, and K. K. Krogman.
Canadian Journal of Plant Science, Vol 61, No 4, p 837-842, 1981. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Water use efficiency, *Soil-water-plant relationships, *Irrigation requirements, Grain crops, *Sorghum, *Barley, *Alberta, Crop yield, Fertilizers, Plant growth.

Grain sorghum and barley were compared with the respect to seasonal water requirements, interaction between water use and applied N fertilizer, and water use efficiency. Sorghum's seasonal water use was 500 mm, 20% greater than for barley because sorghum's growing season is 2 months longer. Peak daily water uses were 6 mm for sorghum and 5 mm for barley. With adequate irrigation both crops showed a linear yield response to applied N up to 80 kg per ha. However, under dryland conditions fertilizer had little effect on sorghum yield. Water use efficiency decreased with increasing water availability for both crops. Maximum yields were achieved under irrigation. In 1979, a growing season favorable for sorghum (warm fall), water use efficiency was close to 1.25 kg grain per cu m of water for complete season irrigation and early season irrigation regimes for both sorghum and barley. Sorghum grain yield was 6900 kg per ha. In 1978, an unfavorable year for sorghum, water use efficiency (in kg grain per cu m of water) was between 0.5 and 1.0 with or without irrigation; 1.25 for irrigated barley and 2.1 for nonirrigated barley. (Cassar-FRC)
W82-04471

COMPARISON OF PRESSURE CHAMBER AND PSYCHROMETER ESTIMATES OF LEAF WATER POTENTIAL IN RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines).
J. C. O'Toole, and T. B. Moya.
Plant and Soil, Vol 62, No 2, p 313-317, 1981. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water potentials, *Leaves, Experimental design, *Rice, Dewpoint, Hydrometers, Hydrometry, Water analysis, Plant water potential, Measuring instruments.

Two rice cultivars, IR 2035-117-3, a modern semidwarf breeding line from the International Rice Research Institute, and Dular, a tall traditional cultivar from northeast India, were grown in 25 cm deep containers in a well fertilized clay-loam soil. Rice leaves were sampled for water potential between 8 and 9 A.M. on each sample date. Measurements of leaf water potential were made on the two cultivars by two measurement methods, from stress and control treatments and from protected and unprotected leaf handling prior to pressure chamber measurement. Sampling was accomplished over a 26 day period. Protection of leaf samples against water loss during excision, transport and handling was found to be more important at higher leaf water potentials. The two cultivars used appeared to differ in their response to protection of the leaf sample. These results serve to further caution pressure chamber users on extrapolating comparisons between the two measurement methods and between tissue handling techniques even with a single crop species. (Baker-FRC)
W82-04541

ANALYSIS OF THE COMPONENTS OF AREA GROWTH OF BEAN ROOT SYSTEMS,
Science and Education Administration, Fort Collins, CO.
E. L. Fiscus.
Crop Science, Vol 21, No 6, p 909-913, November-December, 1981. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Roots, *Water transport, *Plant water potential, Condutance, *Plant growth, *Beans, Hydraulic properties.

Root and shoot growth data are presented for Phaseolous plants grown under two conditions of

light intensity, and discussion is offered on how the distribution of various sizes of roots and their maturation might be related to the mean water transport coefficients and the growth rates for the whole root system. Plants were grown in aerated nutrient solution for 41 days in a greenhouse, under two light intensities, 425 and 300 microE/square meter/second. Determinations were made of leaf area, root area ratios, distribution of root sizes, and the fraction of the total root surface area of each root class. For plants with leaf and root areas greater than 1000 square centimeters, all of these parameters remained stable. They were not changed by light intensity or by growth rate. The mean root system hydraulic conductance appeared to be related to plant size rather than to plant age. In small plants the conductance was very low. Conductance increased about sixfold and peaked when the root systems reached about 1000 square centimeters in surface area. When the root size distribution stabilized in plants larger than 1000 square centimeters conductance gradually declined, probably because of suberization or some other growth related factor. The same pattern of relationships between root system size, root size distribution and hydraulic conductance was noted in plants grown at lower light intensity, except that the overall hydraulic conductance was consistently lower for plants of similar sizes. (Baker-FRC)
W82-04715

2J. Erosion and Sedimentation

TRANSVERSE BED SLOPE IN ALLUVIAL CHANNEL BENDS,
Iowa Univ., Iowa City. Inst. of Hydrological Research.
A. J. Odgaard.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1677-1694, December, 1981. 7 Fig, 2 Tab, 22 Ref.

Descriptors: *Sediment transport, *Slope degradation, *River beds, *Model studies, *Channel erosion, Channel morphology, Channel flow, Banks, Stream erosion, Streambeds, Sacramento River, Shear stress, Particle size, Alluvial channels, Bed load.

Existing models for the prediction of the steady-state transverse bed slope in channel bends and an alternative model developed in this paper were compared using laboratory and field data from the Sacramento River. Flows in alluvial channel bends are difficult to describe because of the helical flow pattern in the bend and its interactionwith the topography of the channel bed. Strong secondary currents combined with a transverse slope of the bed, deeper toward the outer bank, undermine and erode the outer bank. Existing models are based on equations of motion for the sediment particles in the bed load, whereas the writer's model is based on the assumption that the bed topography is determined by the critical conditions for sediment entrainment. All models gave reasonable agreement between measured and predicted slopes at smaller transverse slopes. At larger slopes the writer's model and one other were the only ones giving acceptable agreement. Grain size is a key parameter in all models, but there is no technique which can simulate the spatial variation of the grain size. (Cassar-FRC)
W82-04366

INCIPIENT MOTION OF SAND PARTICLES ON SIDE SLOPES,
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 8D.
W82-04368

SEDIMENTATION RATES AND DEPOSITIONAL PROCESSES IN LAKE SUPERIOR FROM PB210 GEOCHRONOLOGY,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
J. E. Evans, T. C. Johnson, E. C. Alexander, Jr., R. S. Lively, and S. J. Eisenreich.
Journal of Great Lakes Research, Vol 7, No 3, p 299-310, 1981. 4 Fig, 4 Tab, 47 Ref.

Descriptors: *Sedimentation rates, *Lake sediments, Lakes, *Lake Superior, Lake basins, *Trace metals, Shores, Storms, Erosion, Sediment cores, *Cores, Sediment sampler.

Sedimentation rates in Lake Superior ranged from 0.01 to 0.32 cm per year as determined by Pb210 geochronology of 17 sediment box cores taken in representative locations. The western arm of the lake had moderate to high sedimentation rates (0.05-0.11 cm per year), caused by shoreline erosion and resuspension of nearshore sediments. Marginal bays adjacent to the lake had the highest rates (>0.15 cm per year). Open lake regions adjacent to marginal bays had slightly lower rates (0.07-0.19 cm per year). Lowest sedimentation rates (0.01-0.03 cm per year) were in the central basins, which are isolated from sediment sources. Anomalies in Pb210 profiles in the southern and southeastern lake correspondended with severe storms in 1905, 1916-1918, and 1940, the severest storm of the century. These sediment disturbances were produced by resuspension of nearshore and shoal top sediments. Pb210 flux rates range from 0.2-10.0 dpm per sq cm per year, higher than those reported for other lakes. Possible reasons for this are: (1) higher atmospheric deposition rates from uranium bearing rocks or (2) samples collected in shore regions in this study. (Cassar-FRC)
W82-04380

THE EFFECTS OF SEDIMENTATION ON AQUATIC LIFE OF THE KANKAKEE RIVER, PHASE II: QUANTITATIVE STUDIES AND THREATENED, ENDANGERED, AND RARE SPECIES,
Illinois Natural History Survey, Chicago.
For primary bibliographic entry see Field 5C.
W82-04389

NUTRIENT AND HEAVY METAL TRANSPORT CAPABILITIES OF SEDIMENT IN THE SOUTHWESTERN UNITED STATES,
New Mexico Univ., Albuquerque. Dept. of Biology.
J. R. Gosz, C. S. White, and P. F. Ffolliott.
Water Resources Bulletin, Vol 16, No 5, p 927-933, October, 1980. 4 Fig, 4 Tab, 13 Ref.

Descriptors: *Sediment transport, *Chemical analysis, *Phosphorus, Trace metals, *Heavy metals, *Nutrients, Watersheds, Geology, Pine trees, New Mexico, Arizona, Solute transport, Soil types, Vegetation, Comparison studies.

This paper reports on a preliminary test of the hypothesis that sediment of a given size classification derived from small watersheds of uniform bedrock and a single vegetation type would have a uniform nutrient and heavy metal transport capacity. A comparison was made of samples from ponderosa pine communities growing on basalt, sandstone, limestone, and granite bedrock, and a comparison was made between a ponderosa pine community and a mixed conifer community on basalt bedrock. Analyses of acid-digestable and extractable nutrients showed differences for sediments derived from ponderosa pine forests in the Southwest on different geologies. These differences were similar for soil, stream bank, and stream channel material from a given site. Suspended sediment collections had nutrient concentrations similar to those of stream channel collections. Different vegetation on a given geology affected primarily the organic matter content, cation exchange capacity, total phosphorus, and levels of extractable nutrients in sediment. With additional work on other vegetation associations and a larger number of examples for a given bedrock, this approach may allow reasonable estimates of element loss from watersheds, knowing only bedrock composition, vegetation association, and sediment output. (Baker-FRC)
W82-04437

SOIL CONSERVATION SERVICE RUNOFF CURVE NUMBER ESTIMATES FROM LANDSAT DATA,
Science and Education Administration, Athens, GA.
For primary bibliographic entry see Field 7B.
W82-04438

RESERVOIR SEDIMENTATION WITH RANDOM DEPOSITS,
Asian Inst. of Tech., Bangkok. (Thailand).
H. N. Phien, A. Arbhabhirama, and P. Chenyapanich.
Water Resources Bulletin, Vol 16, No 5, 2 Tab, 13 Ref.

Descriptors: *Sedimentation, *Mathematical models, *Sediment discharge, *Reservoirs, Mathematical studies, Model studies, Statistical models, Statistical methods, Markov process, Sediment load, Sediment distribution, Sediment yield.

The volume of sediment accumulated in a reservoir over a period of years was considered as the sum of the annual sediment volumes for those years, which are obtained using the correlation between sediment discharge and river discharge and are treated as random variables in a statistical analysis. If longer records of stream flows are available, the relationship between sediment load and river discharge may function as a transformation of variables by which the distribution of sediment discharge (S) is transferred from the distribution of river discharge (Q). The relationship between these variables may also serve as a data generating system which provides a sediment S-sequence of the same length as the river discharge Q-sequence. Assuming the S- and Q-sequences follow a log-normal distribution, the mean and variance of the sediment volume accumulated in the design was applied to case studies at Kang Khoi on the Pasak River and at Nawarat Bridge on the Ping River, good agreement between values of the S- and Q-sequences were found. (Geiger-FRC)
W82-04443

RESERVOIR SEDIMENTATION AND ITS CAUSES IN ILLINOIS,
Illinois State Water Survey, Urbana.
J. B. Stall, and M. T. Lee.
Water Resources Bulletin, Vol 16, No 5, p 874-880, October, 1980. 6 Fig, 6 Tab, 10 Ref.

Descriptors: *Reservoirs, *Sedimentation, Sedimentation rates, Reservoir silting, Watersheds, Soil erosion, Lakes, *Illinois, Model studies, Computers.

The objectives of this paper were to provide for the state of Illinois a summary of the rates of destruction of impounding reservoirs by sediment deposition; to illustrate the use of the Universal Soil Loss Equation (USLE) to calculate soil losses from every farmer's field, from subwatersheds, and from an entire drainage area; to illustrate a sediment source map for an entire watershed; and to show how this sediment source map can be used to identify areas of the watershed where soil losses are excessive. Detailed surveys were made on 107 lakes. A generalized graph allows annual reservoir capacity loss in percent to be estimated based on size of watershed, lake capacity and watershed ratio. For the 258 square miles of land on the watershed of Lake Springfield, complete soil maps were measured using a graphic digitizer. A computer readable map was produced. The USLE was solved to provide upland soil losses for each area of the watershed. Average watershed soil loss was 3.96 tons per acre per year, and 24% of this was delivered to the lake, meaning that a representative lake in Illinois would have a normal life of 161 years. (Baker-FRC)
W82-04450

BANK FAILURE AND EROSION ON THE OHIO RIVER,
Louisville Univ., KY. Dept. of Civil Engineering.
D. J. Hagerty, M. F. Spoor, and C. R. Ullrich.
Engineering Geology, Vol 17, No 3, p 141-158, 1981. 9 Fig, 3 Tab, 6 Ref.

Descriptors: *Bank erosion, *Mechanical failure, *Erosion, River flow, *Ohio River, Navigation,

Locks, Water level, Boats, Washouts, Infiltration, Land use, Alluvial deposits, Drainage.

Large numbers of riparian landowners along the Ohio River have complained that bank failures and erosion have been caused and/or accelerated by the existence of navigation-aid structures as well as prop turbulence and wave-related erosion by river traffic. Therefore studies were conducted on failure and erosion as well as on river regulation mechanisms. Paintings, photographs and reports revealed a history of significant bank erosion on the Ohio River for more than 150 years, primarily related to storms and high water periods. Construction of larger dams and locks raised retained water levels in some areas. No correlation was found between the ages of given pools and the apparent severity of erosion. During low to moderate flows water levels in the upstream reaches of navigation pools fluctuate somewhat more frequently than water levels immediately upstream from the dams, but fluctuations are smaller than those which occurred prior to dam construction. Based on reconnaissance surveys, bank failure and erosion were found to be a function of bank materials, topography, land use, river morphology and weather cycles. The phenomena are episodic and complex. The principal erosion mechanism appears to be bank material removal by current tractive forces during flood events and internal erosion of bank materials by bank discharge following floods. Landslides at several sites were triggered by periods of greater than average precipitation. Changes in drainage and land use which increase infiltration behind river banks could accelerate this internal erosion mechanism. No significant correlation was found between boat traffic level and bank erosion, but significant site-specific effects are possible. (Carroll-FRC)
W82-04473

EROSION AND SEDIMENTATION IN THE KENAI RIVER, ALASKA,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
K. M. Scott.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.25. Geological Survey Professional Paper 1235, 1982. 35 p, 19 Fig, 5 Tab, 53 Ref.

Descriptors: *Streams, *Channel erosion, *Bank erosion, *Sedimentation, Watersheds, Flow characteristics, Snowmelt, Floods, Bed load, Gravel, Vegetation effects, Fisheries, Salmon, Hydrographs, Aerial photography, *Alaska, *Kenai River.

The Kenai River is the most important freshwater fishery in Alaska. The flow regime is characterized by high summer flow of glacial meltwater and periodic flooding caused by sudden releases of glacier-dammed lakes in the headwaters. Every part of the stream is a known or potential salmon-spawning site. The stream channel is underfit, attributed to regional glacial recession and drainage changes, and locally is entrenched in response to geologically recent changes in base level. Throughout the central section of the river the channel is armored, a condition with implications for the ability of this section of channel to support the spawning and rearing of salmon. The entrenched section of the channel has been stable since 1951. Bank erosion is active both upstream and downstream from the entrenched channel, however. Although erosion rates have been generally constant since 1951, evidence suggests a possible recent decrease in bank stability that may be related to changes in river use. As population and recreation use increases, development can pose a hazard to the productivity of the stream through increased suspended-sediment concentration resulting directly from construction and, with greater potential for long-term impact, indirectly from bank erosion. A short-term hazard to both stream and developments is the cutoff of meander loops, the risk of which is increased by canals and boat slips cut in the surface layer of cohesive, erosion-resistant sediment on the flood plain within nonentrenched meander loops. A long-term hazard is an increase in bank erosion rates resulting from loss of vegetation on the high (up to 70 feet) cutbacks of entrenched and partially entrenched section. (USGS)
W82-04495

ANASTOMOSED RIVER DEPOSITS: MODERN AND ANCIENT EXAMPLES IN ALBERTA, CANADA,
Calgary Univ. (Alberta). Dept. of Geography.
D. G. Smith, and P. E. Putnam.
Canadian Journal of Earth Sciences, Vol 17, No 10, p 1396-1406, October, 1980. 7 Fig, 1 Tab, 41 Ref.

Descriptors: *River beds, *Sediments, *Sedimentation, River basins, Wetlands, Channel flow, Aggrading rivers, Anastomosed deposits, *Canada, Alexandra River, Alluvial deposits, *Braided streams, Alberta, British Columbia.

Anastomosis is suggested as an alternative fluvial system to those of deltaic, braided, and meandering for the deposition of some thick fluvial deposits located in Alberta and British Columbia. An anastomosed fluvial system is a low energy complex of several interconnected channels of variable sinuosity crossing a wetland and forming many elongate vegetated islands. The causal mechanism is either a rising local base level control downriver, or a subsidence of the depocentre relative to a downriver reach. Modern and ancient examples of anastomosis are described to provide a basic depositional framework. One modern example is the lower reach of the Alexandra River in Banff Park. Ancient examples occur in east central Alberta and southwest Saskatchewan. Anastomosed systems have only recently been recognized as a unique fluvial style related to specific causal conditions. Much more field work on modern examples is necessary. (Small-FRC)
W82-04531

HOW RAIN INTENSITY AFFECTS INTERRILL EROSION,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. D. Meyer.
Transactions of the ASAE, Vol 24, No 6, p 1472-1475, November/December, 1981. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Rain intensity, *Erosion, *Sediment transport, Clays, Soil types, *Rill erosion, Soil erosion, Interrill erosion, Runoff, Cropland, Sediment yield, Cultivation, Vegetation effects.

Artificial rainfall was applied to crop row side slopes in fields to determine the effects of rain intensity on interrill erosion. Study sites were farm fields in Mississippi and Iowa. Different soils and cropping conditions were used in the investigation. An equation, $E = aI$ to the b power, where E = erosion rate, a = coefficient of best fit, I = rain intensity, and b = exponent of best fit, was suitable for a wide range of soils and cropping conditions. The exponent b decreased from 2.0 for soils of low clay content to 1.6 for soils with 50% clay. This showed that the influence of rain intensity on erosion was greater for low-clay soils than for high-clay soils, possibly because of greater soil cohesiveness in the higher-clay soils. The equation $E = cI$ squared, where c = ratio of coefficients, fit the data for high clay soils. The relative interrill erodibilities of the different soils or the relative erosion from different cropping conditions are quantitatively indicated by c. (Cassar-FRC)
W82-04537

A KINETIC MODEL FOR SURFACE MINE SEDIMENT YIELD,
Science and Education Administration, Fort Collins, CO.
R. E. Smith.
Transactions of the ASAE, Vol 24, No 6, p 1508-1514, November/December, 1981. 11 Fig, 20 Ref.

Descriptors: *Sediment transport, *Surface runoff, *Strip mines, Sediment yield, *Model studies, *Colorado, *Watershed management, Erosion, Sedimentation ponds, Ponds, Hydrologic models, Runoff, Snowmelt, Land treatment, Vegetation effects, Simulation.

A general watershed runoff and sediment transport model, KINEROS, is given for managing watersheds. Although the model can be applied to a wide range of situations from small urban regions to agricultural watersheds, this paper features its application to a watershed disturbed by surface mining. The major components are infiltration, surface water flow, channel flow, sediment transport, and pond storage. The model is applied to a steep 22-ha watershed established in a strip mine region in western Colorado. Measured and simulated runoff from two summer storms in August 1979 agreed well. Simulation of the April 19, 1979, snowmelt did not produce results comparable to the observed sediment concentrations. Modeling of a sedimentation pond, not yet in operation, indicated the effects of different treatments of surrounding land, such as terraces and vegetative cover. More suitable transport equations are needed for predicting sediment transport on steep watersheds with fine sediments. (Cassar-FRC)
W82-04552

THUNDERSTORM IN AGRICULTURE AND IN FOREST MANAGEMENT,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2B.
W82-04617

THE VORTEX SCOUR MECHANISM AT BRIDGE PIERS,
Zakir Husain Coll. of Engineering and Technology, Aligarh (India).
For primary bibliographic entry see Field 8B.
W82-04642

MATHEMATICAL SIMULATION OF SEDIMENT MOVEMENT IN STREAMS,
Hydraulics Research Station, Wallingford (England).
R. Bettess, and W. R. White.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 879-892, September, 1981. 4 Fig, 14 Ref.

Descriptors: *Sediment transport, *River beds, Sediment sorting, *Model studies, Bed load, Milburn Dam, *Nebraska, *Middle Loup River.

A model for sediment movement in streams was developed and used to predict changes in bed loads and changes in the composition of the bed materials over periods of several years. The model is one-dimensional and time-dependent, and all river properties such as discharge, stage, and bed level, depend only on two variables: the distance along the river and the time. Satisfactory results were obtained when the model was applied to two problems: a laboratory flume test and a field test of a 5200 m reach of the Middle Loup River downstream of Milburn Dam, Nebraska. The observed and calculated bed levels directly downstream of the dam in 1964 were about 1 m less than the original 1961 bed level. (Cassar-FRC)
W82-04650

GROUND-WATER FLOW SYSTEMS AND STABILITY OF A SLOPE,
Woodward-Clyde Consultants, San Francisco, CA.
R. J. Sterrett, and T. B. Edil.
Ground Water, Vol 20, No 1, p 5-11, 1982. 12 Fig, 10 Ref.

Descriptors: *Beach erosion, *Great Lakes, *Artesian pressure, *Groundwater movement, *Slope stability, Erosion, Bank erosion, Slope degradation, Artesian flow, Confined aquifers, Shore protection, Piezometers, Pore pressure, Geologic fractures, Canada, United States.

Receding shorelines along the Great Lakes have resulted in millions of dollars worth of property damage in the United States and Canada. Various projects that have investigated this erosion problem have shown that wave action at the base of the bluff is the main cause of bluff-top retreat. A study of the physical processes which cause bluff erosion

was undertaken with special focus on the role of groundwater in bluff stability. In one section of the Lake Michigan shoreline, an annual bluff-top recession of 9 to 10 m was recorded that was not related to toe erosion. Heads were measured in 25 piezometers at the site and a complex groundwater flow system was found. A glacial sand unit under artesian pressure was detected 5 m above the toe bluff while another 'perched' system existed in a fractured till unit at the top of the bluff. Fluctuations of up to 13 m/year which were recorded in the lower sand unit significantly affected bluff stability. Field data of pore pressures and calculations of the effective strength values of soil units were utilized in slope stability determinations to estimate safety factors. (Geiger-FRC)
W82-04677

DISTRIBUTION OF CLAY MINERALS AND THEIR DIAGENESIS IN THE SEDIMENTS OF LAKE EDKU,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. El Sabrouti, and A. A. Sokkary.
Marine Geology, Vol 45, No 1/2, p M15-M21, 1982. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Diagenesis, *Clays, *Sediments, Shallow lakes, *Lake sediments, Bottom sediments, Organic acids, Organic matter, Montmorillonite, Kaolinite, Illite, Nile Delta, *Lake Edku, Lagoons, Egypt.

Analyses of seven core samples from bottom sediments in Lake Edku, west of the Nile Delta, indicated that these sediments were derived from the Nile River, not from wind-transported sediments. This coastal lagoon varies in depth from 10 to 140 cm and receives inflow from the Mediterranean during dry periods. The major contituent of the sediments was montmorillonite, 47-80%. Illite and kaolinite were present at 7-37% and 6-29%. The proportion of montmorillonite increased and the proportion of illite decreased with increasing sediment depth. Kaolinite also decreased with depth, but to a smaller degree, 4-12%. It is believed that some of the illite was diagenetically changed to montmorillonite through the action of organic acids formed through decomposition of organic matter in the bottom sediments. (Cassar-FRC)
W82-04748

2K. Chemical Processes

HYSTERESIS IN RELATIONSHIPS BETWEEN DISCHARGE AND WATER CHEMISTRY IN THE FRASER RIVER BASIN, BRITISH COLUMBIA,
Department of the Environment, Vancouver (British Columbia).
P. H. Whitfield, and H. Schreier.
Limnology and Oceanography, Vol 26, No 6, p 1179-1182, 1981. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Water chemistry, *Hysteresis, *Fraser River, Rivers, Sampling, Sample preparation, Water sampling, Monitoring, Water quality, Discharge measurement, Load distribution, *British Columbia, *Streamflow-water quality relations.

Analysis of water samples taken from the Fraser River showed a general hysteresis in the discharge-concentration relationship recurring from year to year, with an overall pattern which was remarkably consistent over a 4 year period. The shape of the hysteresis changed more dramatically from one sampling station to another than from year to year. If the hysteresis were symmetrical the overall regression equation would balance the seasonal over- and under-predictions. However, most of the loops are asymmetrical, and yearly predictions thus become more complex and less accurate. Many properties showed hysteresis development when plotted against discharge. Differences were noted not only in the shape of the hysteresis but also in the direction. At some stations the loop developed in a clockwise direction, while in others it was counterclockwise, and in some it crossed over. Several different processes influence the development and shape of the hysteresis, and thus it is not possible to develop a universal model for predicting loadings in the entire river basin. Different rates of nutrient cycling, biological uptake, storage-discharge relationships, and factors relating to climatic and cyclic events are in part responsible for creating a hysteresis. To avoid statistical problems related to serial correlations and hysteresis a complex sampling design is needed, where samples are collected at equal spaces in time and at equal increases in discharge volume. Samples need to be taken often enough to include individual events of high discharge. (Baker-FRC)
W82-04326

WATER CHEMISTRY OF THE ILLINOIS WATERWAY,
Illinois State Water Survey Div., Champaign.
V. Kothandaraman, R. A. Sinclair, and R. L. Evans.
Circular 147, 1981. 23 p, 6 Fig, 15 Tab, 12 Ref.

Descriptors: *Chemical analysis, Physical analysis Water sampling, Streams, *Waterways, Water quality, Data collections, Alkalinity, Dissolved oxygen, Chlorides, Suspended solids, Water temperature, Orthophosphates, Ammonium compounds, Nitrogen compounds, Nitrates, Fluctuations, *Baseline studies, *Lake Michigan, *Water diversion, *Illinois waterway.

A two-year field sampling effort was undertaken by the Illinois State Water Survey to develop baseline water chemistry data prior to increased diversions of Lake Michigan waters into the Illinois Waterway, and to assess the probable impact of the diverted waters on the water chemistry of the waterway. Physical and chemical water quality characteristics are summarized from data obtained at 28 sampling locations established at 10-mile intervals and covering about 270 miles of the waterway. Observations and samples were used to determine temperature, dissolved oxygen (DO), turbidity, pH alkalinity, hardness, chlorides, total solids, suspended solids, orthophosphate-phosphorus, total phosphate-phosphorus, ammonium-nitrogen, and nitrate nitrogen. The waterway was divided into seven reaches and data within each were combined. The Illinois Waterway is high in alkalinity, total solids, and hardness. The pH samples varied from 7.6 to 9.3—within established limits of the Illinois Pollution Control Board. Alkalinity and hardness increased as the river flowed downstream. Ammonia concentrations were higher in the upper reaches of the river as were DO levels. Long-term average mineral and nutrient transports at three USGS gaging stations were made by the flow duration curve method. Nitrate flux at the stations varied from 8.88 to 13.83 lbs/ac/yr and are in the mid-range of values reported for other Illinois streams. Phosphorus loads varied from 1.20 to 2.96 lbs/ac/yr which are several times higher than the values reported for other Illinois streams. (Atkins-Omniplan)
W82-04390

SELECTED HYDROLOGIC RELATIONSHIPS FOR SOLDIER CREEK, NORTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04519

CHEMICAL COMPOSITION OF MONSOON RAINWATER OVER BHOPAL, MADHYA PRADESH (INDIA) DURING 1977 AND 1978,
Indo-British Betwa Groundwater Project, Bhopal (India).
For primary bibliographic entry see Field 2B.
W82-04666

A PHYSICAL REASON FOR HIGHER PH OF TROPICAL RAINWATER,
Meteorological Office, Poona (India).
A. K. Mukherjee, and K. Nand.
Mausam, Vol 32, No 3, p 231-236, July, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Rain, *Carbon dioxide, *Hydrogen ion concentration, *India, Tropical regions, Monsoons, Solubility, Temperature, Air temperature.

Differences in pH of rainwater between northern European countries and tropical countries are explained with respect to the solubility of carbon dioxide at different temperatures. The theoretically calculated pH at 20 C is 5.65, based on the assumption that dissolved carbon dioxide is in equilibrium with atmospheric CO2. The pH of rainwater in India is close to neutral, 7.0. In colder European countries the solubility of CO2 in water is about 1.5 times that in the tropics. In addition, the dissolution rate of CO2 in rainwater is about 1.5 times higher in the colder countries. In the tropics the higher atmospheric temperature, lower solubility and dissolution rate of CO2, and the rapid cloud formation and precipitation result in a higher pH. (Cassar-FRC)
W82-04669

GEOCHEMISTRY OF THERMAL AND MINERAL WATERS IN THE CASCADE MOUNTAINS OF WESTERN NORTH AMERICA,
Oregon Water Resources Dept., Salem.
L. S. Forcella.
Ground Water, Vol 20, No 1, p 39-47, 1982. 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Thermal springs, *Thermal properties, *Chemical properties, *Mineral springs, Hydrogen ion concentration, Ions, Water properties, Geohydrologic units, Geohydrology, Geothermal studies, Geothermal resources, Mineral water, Geophysics, *Cascade Mountains, Washington, Oregon.

The chemistry of thermal and mineral waters in the Cascade Mountains was examined as a basis for future comparisons with other hydrothermal systems and for future development of geothermal resources. The thermal and mineral waters from the Cascades may be classified into three chemically distinct groups. Group 1 exhibits a neutral pH, an average total dissolved solids (TDS) value of 2650 ppm, and dominant Na and Cl ions. Group 1 waters issue from the geothermally attractive Central Cascades and were probably in prolonged contact with Eocene marine sediments during the Mesozoic era. Group 2 waters are fumarolic acid-sulfate waters from the vents of Mt. Lassen, Newberry Crater and Mt. Hood. Basic brines discharge from the base of Mt. Lassen and Mt. Hood. The Group 3 waters are characterized by chemical inhomogeneity between different points of discharge. Dominant ions are Cl, Na, HCO3, and SO4 and the pH ranges from 6.2 to 9.7. The thermal waters of the Cascade Province have been subject to various degrees of mixing and proximity to heat which might account for the chemical differences. (Geiger-FRC)
W82-04673

INFLUENCE OF AN AMERICIUM SOLID PHASE ON AMERICIUM CONCENTRATIONS IN SOLUTIONS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W82-04720

THE BIOGEOCHEMISTRY OF SULFUR IN TWO SMALL LAKES,
For primary bibliographic entry see Field 2H.
W82-04726

ISOTOPE GEOCHEMISTRY OF WATER IN GULF COAST SALT DOMES,
Arizona State Univ., Tempe. Dept. of Geology.
L. P. Knauth, M. B. Kumar, and J. D. Martinez.
Journal of Geophysical Research, Vol 85, No B9, p 4863-4871, September 10, 1980. 2 Fig, 1 Tab, 32 Ref.

Descriptors: *Geochemistry, *Isotope studies, *Salt domes, Meteoric water, Chemical composition, Oxygen, Hydrogen, Salt mines, Saline water, Groundwater, Louisiana, *Gulf of Mexico, Weeks Island, Jefferson Island, Belle Isle.

Water has occasionally been found to enter newly excavated chambers in salt domes along the northern coast of the Gulf of Mexico from ceiling drips,

wall seeps, and exploratory boreholes. An understanding of the origin of this water is extremely important in evaluating the suitability of salt domes as isolation sites for nuclear waste proucts. Possible origins include connate waters that have been in the salt since deposition and waters external to the dome which have somehow penetrated or become incorporated into the salt. The hydrogen and oxygen isotopic composition of water samples collected from salt mines on Weeks Island, Jefferson Island, and Belle Isle in southern Louisiana were analyzed in an effort to determine the origin of the water. Two samples were found to be isotopically similar to local surface waters and clearly of meteoric origin. All of the other samples were too enriched in oxygen-18 to be meteoric waters. Water derived from active leaks in three mines on Weeks Island was too enriched in oxygen-18 and too depleted in D to be connate ocean water or evaporite connate water trapped in the salt. It is unlikely that the water originated from the dehydration of gypsum or that isotopic exchange with anhydrite is responsible for the oxygen-18 enrichments. It is concluded that the nonmeteoric waters are saline formation waters which have become incorporated in the salt. The observed oxygen-18 enrichments suggests that the formation waters were incorporated during diapiric rise of salt at a depth of 3 to 4 kilometers and have been trapped within the salt for between 10 and 13 million years. The presence of limited amounts of such trapped formation water in the salt within salt domes will have to be considered when planning radioactive waste storage in salt domes. (Carroll-FRC)
W82-04742

2L. Estuaries

SURVIVAL AND HETEROTROPHIC ACTIVITIES OF FRASER RIVER AND STRAIT OF GEORGIA BACTERIOPLANKTON WITHIN THE FRASER RIVER PLUME,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
M. Valdes, and L. J. Albright.
Marine Biology (Berlin), Vol 64, No 3, p 231-234, 1981. 9 Fig, 3 Tab, 40 Ref.

Descriptors: *Nutrients, *Plumes, Rivers, Carbon, Nitrates, Phosphorus, *Bacteria, *Estuaries, Plankton, Fraser River, Strait of Georgia, *British Columbia, Canada.

Subsurface samples of water were taken from various locations in the Fraser River, its plume and the Strait of Georgia and use for experimental purposes within 1 hr of collection. The majority of the autochthonous heterotrophic bacterioplankton of the lower Fraser River appeared to be killed when placed in marine water taken from the Strait of Georgia. However, their marine counterparts with Strait of eorgia surface water remained viable when treated with Fraser River water. Within the plume water a stimulation of glucose heterotrophic activity occurred within the salinity range of about 3-18 0/00. The plume water itself arises naturally when the freshwater of the Fraser River mixes with the marine water of the Strait of Georgia. This increase in bacterioplankton activity may be a result of a better nutrient environment within plume water as compared to either parent water. It is noted that there is a well distributed and relatively high inorganic carbon, nitrate and phosphorus content in the plume water, which makes it more nutritionally complete for acteria than either of the other waters. (Baker-FRC)
W82-04291

ELECTROMAGNETIC MEASUREMENTS OF TIDAL TRANSPORTS IN ESTUARIES,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 7B.
W82-04296

ICHTHYOPLANKTON SAMPLERS FOR SIMULTANEOUS REPLICATE SAMPLES AT SURFACE AND BOTTOM,
North Carolina State Univ. at Raleign. Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W82-04297

THE EFFECT OF DRIED AND CRACKED SEDIMENT ON THE AVAILABILITY OF PHOSPHORUS IN A COASTAL LAGOON,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Biologia.
V. Arenas, and G. De La Lanza.
Estuaries, Vol 4, No 3, p 206-212, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Lagoons, *Phosphorus, Nutrients, Estuaries, Estuarine environment, Cycling nutrients, *Mexico, Coastal waters, Water level, Aquatic plants, Sediments, *Caimanero Lagoon, Dry sediment.

The effect of dried and cracked sediments on the availability of nutrients such as phosphorus in coastal ecosystems was investigated. The study area was the Caimanero Lagoon, which is subject to alternate periods of low water and flooding. In times of low water, more than 70% of the lagoon area is dry, cracked and colonized by halophytes to variable proportions. Mineralization of organic matter occurs during these dry times and reavailability of phosphorus takes place to a great extent. The amount of soluble organic matter also increased during the dry seasons. It was established that the sedimentary drying and cracking process contributed significantly to estuarine productivity, probably due to the ability of algae to utilize the phosphorus from organic sources. (Baker-FRC)
W82-04299

OREGON COASTAL SALT MARSH UPPER LIMITS AND TIDAL DATUMS,
Oregon State Univ., Corvallis.
R. E. Frenkel, H. P. Eilers, and C. A. Jefferson.
Estuaries, Vol 4, No 3, p 198-205, 1981. 4 Fig, 3 Tab, 18 Ref.

Descriptors: *Salt marshes, Coastal zone management, Wetlands, *Tidal marshes, Marshes, *Oregon, *Coastal marshes, *Saline-freshwater interfaces, Saline water intrusion.

Independent surveys were made of three coastal salt marshes to determine the upper limit of marsh. The areas of study included South Beach marsh of the Yaquina River estuary, Drift Creek marsh of the Alsea River estuary, and Bandon marsh of the Coquille River estuary. Primary tidal data are relatively infrequent for the Oregon Coast. Of the marshes studied, only South Beach had dependable data. The relation of tidal datum planes to National Geodetic Vertical Datum (NGVD) was not readily available and was determined from vertical control data for bench marks. A transition zone between marsh and upland was identified by strong dominance of Potentilla pacifica and the presence of Achillea millefolium, Angelica lucida, Aster subspicatus, Oenanthe sarmentosa, Trifolium wormskjoldii, and Vicia gigantea. The mean elevation of the lower boundary of the transition zone was 1.38 meters above NGVD and the upper boundary of the transition zone was 1.54 meters above NGVD. The relation of the upper limit of marsh to tidal datums varied with marsh. The mean elevation of the upper and lower limit of the transition zone was 0.58 meters above MHW and 0.36 meters above MHW, respectively. Two teams of biologists using the same biological criteria for defining the upper limit of marsh independently agreed on the elevational position of the upper limit of marsh. Additional research on defining the upper limit of coastal marsh is needed.
W82-04312

NUTRIENT MASS BALANCES FOR THE WATERSHED, HEADWATERS INTERTIDAL ZONE, AND BASIN OF THE RHODE RIVER ESTUARY,
Chesapeake Bay Center for Environmental Studies, Edgewater, MD.
D. L. Correll.
Limnology and Oceanography, Vol 26, No 6, p 1142-1149, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Estuaries, *Nutrients, Nutrient removal, *Rhode River Estuary, Maryland, Rivers, Cycling nutrients, Organic matter, Nitrogen, Phosphorus, Seasonal variation, Path of pollutants.

Measurements were made of the dynamics of nitrogen, phosphorus, and organic matter content in the basin, headwaters, intertidal zone and watershed of the Rhode River Estuary. Inputs from precipitation and both surface and groundwater runoff were measured continuously, as well as the tidal flux between the intetidal zone and the main estuarine, open water basin, for a 13-month period. The watershed is dominated by agriculture and secondary successional vegetation, 88 ha of todal marshes and mudflats, and an estuarine open water basin. Less organic matter moved out to the estuary than was discharged into the intertidal zone from the watersheds and deposited in precipitation. Only 1.9 tons of the 2.7 tons of phosphorus discharged from the uplands into the intertidal zone moved into the estuary. In most instances a high discharge of phosphorus from the watersheds was followed in a week or two by a high discharge into the estuary from the intertidal zone. A significantly lower fraction of the total phosphorus moving into the estuary was made up of orthophosphate than had been anticipated based on the amount of orthophosphate moving from the watershed. Of the 10 tons of nitrogen discharged from the watershed into the intertidal zone, only 7.4 tons moved into the estuary. Thus overall removal and storage of nutrients from land runoff by the intertidal zone is apparent. Only when runoff was high due to storms were some of the stored nutrients flushed from the intertidal zone. (Baker-FRC)
W82-04330

VERTICAL MIXING AND PHOTOSYNTHETIC CAPACITY OF ESTUARINE PHYTOPLANKTON (MELANGE VERTICAL ET CAPACITE PHOTOSYNTHETIQUE DU PHYTOPLANCTON ESTUARIEN (ESTUAIRE DU SAINT-LAURENT)),
Laval Univ., Quebec. Dept. de Biologie.
S. Demers, and L. Legendre.
Marine Biology (Berlin), Vol 64, No 3, p 243-250, 1981. 5 Fig, 45 Ref. English summary.

Descriptors: *Estuaries, *Phytoplankton, Vertical distribution, *St. Lawrence Estuary, Vertical distribution, Chlorophyll, Photosynthesis.

Water samples were collected hourly for 167 hours in August of 1975 at an anchor station in the Middle Estuary of the St. Lawrence River, Canada. These samples served as a time series for measuring chlorophyll a, photosynthetic capacity and many physical parameters. Sampling was conducted during the transition from neap to spring tides. Variations in chlorophyll a, both long and short-term, are coupled with the advection of water masses, which in turn depends on the tidal currents. The chlorophyll a concentration of the cells is also influenced by the vertical mixing, as it modifies the physiological state of the phytoplankton. Periodicities were also noted in the photosynthetic capacity, suggesting that the phytoplankton of this area have a homogeneous light history due to strong vertical mixing. The photosynthetic capacity is adapted to the mean light intensity in the mixed layer under these conditions. Semi-monthly variations of the mean light intensity in the mixed layer depend on the semi-monthly variations in the vertical mixing, whereas in the short-term, the variations in mean light intensity in the mixed layer are circadian. (Baker-FRC)
W82-04331

SUNLIGHT INDUCED MOVEMENT OF PLANKTONIC ORGANISMS AND THEIR RELATIONSHIPS TO WATER MOVEMENTS,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 2H.
W82-04417

EVIDENCE FOR COEXISTENCE OF TWO DISTINCT FUNCTIONAL GROUPS OF SULFATE-REDUCING BACTERIA IN SALT MARSH SEDIMENT,

Essex Univ., Colchester (England). Dept. of Biology.
I. M. Banat, E. B. Lindstrom, D. B. Nedwell, and M. T. Balba.
Applied and Environmental Microbiology, Vol 42, No 6, p 985-992, December, 1981. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Bacteria, *Sulfates, *Sediments, *Salt marshes, Sulfides, Sulfur bacteria, Molybdates, Fluoroacetates, Oxidation, Marine sediments, Marshes, Estuarine environment, Wetlands, Lake sediments, *England, Ray Creek, Colne Point Marsh, United Kingdom.

Two types of sulfate-reducing bacteria, one oxidizing acetate and one probably oxidizing hydrogen, were found in the salt marsh sediments of Ray Creek, Colne Point Marsh, United Kingdom. Acetate oxidation was partially inhibited by addition of fluoroacetate, a known inhibitor of acetate metabolism. Molybdate completely inhibited acetate oxidation. It apparently acts by suppressing adenosine triphosphate sulfurylase, common to both groups of bacteria. Acetate metabolism in freshwater pond sediments in the absence of sulfate was not affected by molybdate but was inhibited by fluoroacetate. Acetate was oxidized to carbon dioxide, not to methane. (Cassar-FRC)
W82-04464

DEPTH, SILT AND CURRENT: FACTORS IN THE TRANSVERSE MICRODISTRIBUTION OF THE BENTHOS IN THE FRESHWATER ESTUARY OF THE ST. LAWRENCE (PROFONDEUR, VASE ET COURANT, FACTEURS DE MICROREPARTITION TRANSVERSALE DU BENTHOS DANS L'ESTUAIRE D'EAU DOUCE DU SAINT-LAURENT (QUEBEC),

Quebec Univ., Trois-Rivieres. Dept. of Chemistry-Biologie.
B. Vincent.
Canadian Journal of Zoology, Vol 59, No 12, December, 1981. 3 Fig, 3 Tab, 29 Ref. English summary.

Descriptors: *Estuarine environment, *Species composition, *Benthic fauna, Silt, Flow velocity, *St Lawrence River, Water currents, Water depth, Rivers, Species diversity, *Spatial distribution.

To study the spatial variability of the faunal characteristics and numbers and relate them to the abiotic factors prevailing at various locations, benthic samples were collected with a Ponar bucket at 33 locations on a transect of the upper St. Lawrence estuary. Data were simultaneously obtained on the physicochemical characteristics of the water, water depth, silt content of the surface sediments, and current speed. The principal taxonomic groups represented were oligochaetes (34.4%), hirudinea (4.9%), gastropoda (38.1%), sphaeriidae (19.6%) and chironomids. The physico-chemical characteristics of the water were fairly stable. The most abundant species followed a definite zonation, but no species was truly typical of any one habitat. Depth, percentage of silt, and current velocity, in decreasing order, affected the structure of the benthic associations. The diversity was independent of these factors, but the organism density, number of taxa, and equitability were all significantly correlated with the percentage of silt. (Carroll-FRC)
W82-04472

EFFECT OF RIVER DISCHARGE ON THE DISTRIBUTION PATTERN OF DISSOLVED CONSTITUENTS IN THE GAMO ESTUARY, MIYAGI PREFECTURE,

Tohoku Univ., Sendai (Japan). Biological Inst.
E. Kikuchi, and Y. Kurihara.
Japanese Journal of Limnology, Vol 42, No 2, p 100-107, 1981. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater pollution, *Dissolved solids, *Phytoplankton, *Estuaries, *Gamo Estuary, Nanakita River, *Japan, Rivers, Nutrients, Nitrates, Chlorides, Phosphates, Ammonium, Dissolved oxygen, Oxygen, Eutrophication, Diatoms, Cytocella, Ciliates, Mesodinium, Salt wedge estuaries, Saline-freshwater interfaces, Sendai Bay.

Chlorinity, dissolved inorganic nitrogen, phosphate, and dissolved oxygen were measured at 7 sites in the Gamo estuary, Japan, a salt wedge estuary highly polluted with domestic sewage. A weir is located about 4.2 km upstream from the mouth. Sampling sites were locaied from the mouth to 4 km upstream and at different depths from the surface to the bottom, which ranged from 1 m deep at the mouth to 5 m deep in a trough. Ammonium and phosphate concentrations increased with distance upstream, and dissolved oxygen decreased with distance upstream. Levels of ammonium and phosphate increased with depth. Dissolved oxygen concentrations decreased with depth, reaching zero at the bottom of a trough. These results indicate that the deeper water was trapped in basins by shallow sills for long periods. Nitrate concentrations were higher in the fresh surface water than in the saline bottom water. The effect of the tide on the dissolved constituents was almost negligible in the estuary except near the mouth. In the brackish surface water dissolved oxygen levels were high, and ammonium, nitrate, and phosphate levels were very low. A phytoplankton bloom at low flow in summer was dominated by diatoms (Cytocella) in the fresh surface water and ciliates (Mesodinium) in the saline water. (Cassar-FRC)
W82-04543

SALINITY INTRUSION IN ESTUARIES,

Institute of Oceanographic Sciences, Merseyside (England).
D. Prandle.
Journal of Physical Oceanography, Vol 11, No 10, p 1311-1324, October, 1981. 7 Fig, 2 Tab, 30 Ref.

Descriptors: *Saline water intrusion, *Tidal effects, *Mixing, *Estuaries, Rivers, Model studies, Salinity, Fate of pollution, Dispersion coefficient.

One-dimensional solutions were examined for thd degree of saline water intrusion into estuaries of different shapes. These solutions emphasize the importance of the rate of change of cross-sectional area in determining salinity distribution. The salinity distribution was shown to be highly dependent on the dimensionless parameter VI, which equals U1 x X1 divided by D, where U1 = velocity of freshwater flow at position X1, the point where the salinity of the estuary equals the oceanic value, and D = longitudinal dispersion coefficient. The predicted and observed salinity distributions were compared for 8 estuaries. The values of D were within the range of 50-500 sq m per sec for 6 estuaries (Hudson, Potomac, Delaware, Bristol Channel, Thames, and St. Lawrence). Since salinity distribution is highly sensitive to the specified value of D, the one-dimensional, time-averaged approach may be limited. Attempts to derive a more rational dimensionless form for the longitudinal dispersion coefficient in terms of gross estuarine parameters were not successful. (Cassar-FRC)
W82-04574

REQUIREMENTS FOR CONTINUOUS AUTOMATIC WATER QUALITY MONITORING IN THE THAMES ESTUARY,

Thames Water Authority, London (England).
A. G. Cockburn, and R. J. Furley.
Water Science and Technology, Vol 13, No 11/12, p 693-698, 1981. 3 Fig, 5 Ref.

Descriptors: *Estuaries, *Water quality, Monitoring, Estuarine environment, Water management, Measuring instruments, *Thames River, Rivers, Water pollution control, Water management, England.

The paper discusses the reason for automatic continuous monitoring on tidal rivers and the requirements of such a system in the Thames Estuary. The Tidal Thames is a well mixed estuary stretching some 140 kilometers from Teddington, through the heart of London, th the North Sea. Prior to 1960 the Tideway was anaerobic and devoid of all fish life for much of its length, but improvements in effluent quality have resulted in minimum average dissolved oxygen concentrations of 30% in recent years and the consequent return of large fish populations. Automatic continuous water quality monitoring should prove an efficient and cost effective management tool in the continuing improvement of the Tidal Thames. Running costs including servicing requirements will be less than those currently incurred by manual sampling and analysis using launches, and the information obtained will be much more complete. Significant storm sewage discharges occur in the uppermost 30 kilometers of the estuary, where dilution is small; these can cause sudden severe depletion in dissolved oxygen and consequent fish mortality. It is possible to alleviate the situation by direct injection of pure oxygen into the river by barges towed to the appropriate locations. For this method to be viable, continuous monitoring, together with appropriate telemetry, is essential to give early warning of deteriorating water quality and proper operational control. Site selection for water quality monitoring programs is absolutely critical. (Baker-FRC)
W82-04591

A SUSPENDED SEDIMENT FRONT IN THE SEVERN ESTUARY,

Institute of Oceanographic Sciences, Taunton (England).
R. Kirby, and W. R. Parker.
Nature (London), Vol 295, No 5848, February, 1982. 5 Fig, 12 Ref.

Descriptors: *Estuaries, *Suspended sediments, Sediments, Salinity, Sedimentation, Estuarine environment, Topography, Coriolis force, Tidal effects, *Severn Estuary, *England.

The structure of the suspended solids field was observed in the Severn Estuary using a free-fall array consisting of two narrow-gap optical turbidity meters, a pressure depth sensor, and occasionally a continuously recording conductivity meter, allowing continuous and rapid vertical profiles to be made from drifting or anchored vessels. The regional spring surface and spring bed distributions show the sediment front as a zone of marked gradient approximately along the axis of the estuary between The Shoots and the Holm Islands, and extending across the inner Bristol Channel to the English coast in the region of Watchet, in Bridgewater Bay. The more turbid water mass lies on the English side of the estuary. On neap tides the regional distribution was similar, although the contrast between surface and bed concentration values is greater. Data plots showed that the sediment front was more prominent on spring than on neap tides and on ebb rather than flood tides. Steeply inclined concentration contours were noted across the gradient zone in the region between The Bridge and a line joining Barry and Burnham. The front may be due to an interaction between the regional and local topography. Coriolis effects and lateral phase differences in tidal elevation across the estuary, which set up secondary water circulation cells in the plane of the cross-section, leading to convergence along the main channel axis. It is concluded that the Severn estuary, while well mixed with regard to salt, shows marked lateral partitioning of suspended sediment, with a stably positioned front forming the junction between the two water masses. (Baker-FRC)
W82-04639

DISPERSION COEFFICIENTS IN ESTUARIES,

Birmingham Univ. (England).
For primary bibliographic entry see Field 5B.
W82-04684

SHEET FLOW IN A SALT-MARSH BASIN, NORTH INLET, SOUTH CAROLINA,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
J. L. Miller, and L. R. Gardner.
Estuaries, Vol 4, No 3, p 234-237, 1981. 4 Fig, 13 Ref.

Descriptors: *Laminar flow, *Salt marshes, Stratification, Tidal prism, Water storage, Estuaries, Estuarine environment, Tidal marshes, *South Carolina, North Inlet area, Saline-freshwater interfaces.

This paper evaluates the magnitude of sheet flow in a small marsh basin near North Inlet, South

Carolina by comparing basin storage curves determined by current measurements with a basin storage curve based on direct measurements of marsh topography and hypsometry. The basin is well outlined by terrestrial vegetation. The study indicated that on spring tides, more than 50% of the tidal prism that enters Oyster Landing basin enters as sheet flow over the grassy flats of the marsh. The discharge data also suggest that the storage curve for the basin may be a hystersis loop with separate flood and ebb segments. (Baker-FRC)
W82-04716

SEASONAL CHANGES IN THE DEPTH DISTRIBUTIONS OF INTERSTITIAL SALINITIES IN THE FRASER RIVER ESTUARY, BRITISH COLUMBIA,
Victoria Univ. (British Columbia). Dept. of Biology.
P. M. Chapman.
Estuaries, Vol 4, No 3, p 226-228, 1981. 2 Fig, 11 Ref.

Descriptors: *Sediments, *Interstitial water, *Salinity, *Fraser River estuary, Estuaries, *British Columbia, Estuarine environments, *Seasonal variation, Stratification.

Results of a study of vertical and temporal variations in the interstitial salinities of subtidal estuarine sediments are presented. The study was carried out at six stations in the Fraser River estuary spaced to encompass the whole spectrum from freshwater to salt water regions. Stations were sampled monthly in replicate at four sediment depths, and horizontal and vertical changes in interstitial salinity were recorded. The main pattern of flow in the Fraser River is a constant one of low discharge in winter, medium discharge in autumn, and highest discharge between May and June. Maximal salinities occur over winter and minimal salinities during freshet. The seasonal pattern of interstitial salinities at all stations reflected this trend. Interstitial salinities were conservative and reflected seasonal changes in the salinity of the overlying water. These seasonal changes in interstitial salinity are probably due to diffusion. Definite salinity gradients were present in the sediments, particularly in the mesohaline zone of the estuary, and the magnitude of these gradients changed seasonally. It is suggested that interstitial salinity gradients may be a common feature of estuaries. (Baker-FRC)
W82-04717

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

JEDDAH IV SEAWATER DESALINATION AND POWER PLANT IN OPERATION IN SAUDI ARABIA (MEERWASSERENTSALZUNGS UND KRAFTANLAGE JEDDAH IV IN SAUDI - ARABIEN IN BETRIEB),
G. Marotz.
Wasserwirtschaft, Vol 71, No 12, p 377-378, 1981. 1 Fig, 1 Ref. (No English summary).

Descriptors: *Desalination, *Distillation, *Powerplants, Jeddah, *Saudi Arabia, *Red Sea, Seawater, Boilers, Turbines, Water supply, Water treatment.

The Jeddah IV seawater desalination and power plant was put into operation in Saudi Arabia on October 24, 1981. This is currently the largest such plant in the world, and upon full operation will supply about 220,000 cu m of drinking water per day. It is located on the Red Sea, about 8 km north of the city of Jeddah. It covers an area of 20 hectares and supplies electrical energy as well as water. Five oil-fired boilers produce 605 t/hr of steam which is used to run the turbines and as the desalination starting product. The basic process for desalination is multi-stage flash distillation. Ten desalination sections can be operated independently, at a brine temperature of 112 C. Sulfuric acid is added to prevent the deposition of magnesium hydroxide and calcium carbonate in the evaporator-condenser chambers. The boiler supply and cooling water (43 cu m/sec at full capacity) is collected at 16 m below the sea surface, and prepurified with rakes and band filters. Oil is delivered by tank ship, with sufficient storage capacity on site for 32 days of operation. (Carroll-FRC)
W82-04581

DESIGN, FABRICATION AND START-UP OF A 25,000 GALLONS PER DAY ABSORPTION FREEZING VAPOR COMPRESSION DESALINATION PILOT PLANT.
Concentration Specialists, Inc., Andover, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220526, Price codes: A04 in paper copy, A01 in microfiche. Report, May, 1981. 63 p, 8 Fig, 1 Tab, 1 Append. 14-34-0001-8502.

Descriptors: *Desalination plant, *Freezing, *Vacuum, *Absorption, Pilot plant, Ice-brine systems, Refrigeration, Electric power demand, Specifications, *Wrightsville Beach, North Carolina, Test facility.

Concentration Specialists, Inc. designed, built, initiated start-up and began operational testing of a 25,000 gallons per day adsorption freezing vapor compression (AFVC) sea water desalination plant at the Office of Water Research and Technology's Test Facility at Wrightsville Beach, North Carolina. The AFVC process is a novel freezing process based upon an absorption cycle powered by a heat pump. The energy savings and lack of corrosion of freezing compared to evaporative processes is a significant feature of this process. The pilot plant was designed to produce 25,000 gallons per day of fresh water while consuming 49 kWh of energy per 1000 gallons of product water. Upon design and fabrication, start-up and operational testing of the pilot plant has shown the need for considerable process and component modification as would be expected with a developmental process. By the end of the contract period, June 1980, the pilot plant produced 8000 gallons per day of product water under non-steady state operating conditions. Equipment modification continues toward increasing plant capacity and achieving steady state production.
W82-04724

3B. Water Yield Improvement

WILL NEW ORLEANS MISS THE MISSISSIPPI,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-04274

3C. Use Of Water Of Impaired Quality

REUSE OF BIOLOGICALLY TREATED WASTEWATER AS COOLING TOWER MAKEUP,
R. J. Franco, J. C. Wykowski, and J. Delaunay.
Industrial Water Engineering, Vol 18, No 5, p 14-19, September-October, 1981. 3 Fig, 8 Tab, 1 Ref.

Descriptors: *Water reuse, *Cooling water, *Industrial wastewater, Impaired water use, Water treatment, Wastewater treatment, Water softening, *Fos Refinery, *France, Heat transfer, Corrosion control, Filtration, Ammonia, Pilot plants, Biological treatment, Chromates, *Oil refineries, Biocides, Bacteria, Scaling.

Pilot plant studies at the France, demonstrated that ammonia-containing refinery wastewater effluents could be successfully used in cooling towers with addition of chromate corrosion inhibitors and appropirate water treatment. The effluent contained 20-50 mg per liter ammonia, which encouraged biological fouling. This was controlled by shock chlorination, supplementary biocides, and the chromate inhibitor (zinc chromate phosphate). Isothiazolin was effective in depressing bacterial counts, but the other antibacterials tested (methylene bisthiocyanate, sulfone, and acrolein) permitted rapid regrowth of bacteria. Scaling was minimized by softening the water to reduce total hardness from 340 to 87 mg per liter as CaCO3. Suspended solids should be less than 10 mg per liter. Filtration and an alternate water supply must be available in case of wastewater treatment upsets. Non-chromate inhibitors (two polyphosphate-phosphonates and zinc polyolester) did not adequately protect the system against corrosion and loss of heat transfer. They allowed growth of sulfate-reducing bacteria. Use of the effluent in cooling towers will result in significant reductions of water use, water discharge, and contaminant discharge. (Cassar-FRC)
W82-04317

REFUSE OF POWER PLANT COOLING WATER FOR IRRIGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, H. J. Vaux Jr., and L. H. Stolzy.
Water Resources Bulletin, Vol 16, No 5, 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Powerplants, *Groundwater management, *Water reuse, *Cooling water, *Irrigation practices, California, Water policy, Saline water, Water quality management, Hydroelectric plants, Environmental protection, Evaporation, Impaired water use.

California water policy at present requires saline blowdown waters from powerplants to be disposed of in sealed evaporation ponds to prevent deterioration of groundwater. This policy attempts to strike a balance between demand for energy and environmental protection goals. Saline blowdown waters may be used in the irrigation of certain salt tolerant crops. When the irrigation is managed carefully, residual salts may be stored in the soil profile with litter potential for harming groundwater. Studies of blowdown irrigation water discharge below a successful irrigation project indicated a downward movement of salts below the root zone, but no farther than with conventional blowdown water disposal techniques. The reuse of blowdown waters for irrigation proved less costly than storage in evaporation ponds. These analyses showed that irrigation reuse of blowdown water is a viable means of saline water disposal within the existing standards of groundwater quality protection. (Geiger-FRC)
W82-04445

WATER RECYCLING/REUSE IN THE FOOD PROCESSING INDUSTRY,
Montgomery (James), Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 5D.
W82-04566

APPLICATION OF THE WASTEWATER EFFLUENT OF A RURAL COMMUNITY TO A MOUNTAIN MEADOW,
Colorado E Agricultural Experiment Station, Fort Collins.
For primary bibliographic entry see Field 5E.
W82-04705

THE CHEMISTRY OF SALINE WATER CHLORINATION,
Tennessee Univ., Knoxville.
W. R. Haag.
PhD Thesis, June, 1981. 165 p, 24 Fig, 5 Tab, 119 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-23155.

Descriptors: *Model studies, *Chlorination, *Saline water, *Chemical reactions, Industrial water, Cooling water, Powerplants, Environmental effects, Bromine.

A review of the present state of knowledge of natural water chlorination chemistry was performed, with particular reference to saline waters.

Experimental work demonstrated that bromochloramines can readily form under conditions of power plant cooling water chlorination, if saline water is used. Further experimental work explained the results of previous workers by showing that chlorine losses at very high doses in seawater are simply the result of chlorate and bromate formation which is negligible at normal doses. The most important chlorine-produced oxidants, along with the relevant chemical reactions, were chosen as a basis for a kinetic model of saline water chlorination chemistry. Kinetic data were compiled in a computer program which simultaneously solves 24 differential equations, one for each species modelled. Estimates were made for the unknown rate constants, with the hope that measured values would be determined by future researchers. A purely predictive model was not possible due to the great variability in the organic demand; however, the model is applicable under a broad variety of conditions (except sunlight), and its provides a reasonably good description of a halamine chemistry under environmental conditions. (Sinha-OEIS)
W82-04729

3D. Conservation In Domestic and Municipal Use

CONSERVING WATER THROUGH PRICING,
State Univ. of New York at Albany.
E. F. Renshaw.
Journal of the American Water Works Association, Vol 74, No 1, p 2-5, January, 1982. 4 Fig, 11 Ref.

Descriptors: *Water conservation, *Water shortage, *Pricing, Water demand, Water use, Economic aspects, Social aspects, Domestic water.

The success of water conservation efforts and availability of new technologies for reducing water consumption in households and industries suggest that conservation opportunities should be explored before projects to augment water supply are initiated. Classical economic theory illustrates the benefits of pricing water at the long-run marginal cost rather than the long-run average cost. The regressive nature of such a pricing policy could be combated by giving lump sum credits to deserving households or businesses, independent of actual water use. Lifeline rates and progressive rate structures have considerable appeal, but are neither an efficient way to ration water nor an equitable way to redistribute income. To maximize social benefits from water it is necessary to minimize social costs, which consist of cost to the utility of supplying water and the loss of consumer surplus that is likely to result from a water shortage. While nonprice rationing has achieved a high degree of social acceptance in communities that have experienced a water shortage, it will usually result in a larger economic loss than would be the case if wate were rationed by means of a higher price. A temporary system of penalty rates for excessive use and conservation credits would encourage more rational allocation of available water during shortages. Such systems appear to be acceptable by the public. (Carroll-FRC)
W82-04272

THE ADOPTION OF MUNICIPAL WATER CONSERVATION: AN UNLIKELY EVENT,
Oklahoma State Univ. Stillwater. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W82-04343

LEAK DETECTION--HISTORIES,
Alvord, Burdick and Howson, Chicago, IL.
J. E. Pilzer.
Journal of the American Water Works Association, Vol 73, No 11, p 565-567, November, 1981.

Descriptors: *Leakage, *Water distribution, Water conservation, *Water loss, *Water supply systems, Municipal water.

Several case histories of leak detection in water systems are reported from a survey of water companies and consultants by the American Water Works Association leak detection committee. In most cases discovery of leaks, some very large and some multiple small leaks, saved considerable water and money. A practical leak detection program can start with a modest overall study to determine where pinpoint leak detection would be most productive. Review of records can identify areas for closer scrutiny. The leak survey may be performed by water company personnel or an outside consultant. It is important to use the proper detection equipment, which filters some of the background noise that makes detection difficult. As energy and chemical costs escalate, leak detection should be considered even in systems with relatively low losses. (Cassar-FRC)
W82-04363

LEAK DETECTION PROGRAMS RECOVER REVENUES,
Community Consultants, Inc., Provo, UT.
S. E. Sowby.
Journal of the American Water Works Association, Vol 73, No 11, p 562-564, November, 1981. 2 Fig.

Descriptors: *Leakage, *Water metering, *Water distribution, Water conservation, *Operating costs, Water loss, Municipal water, Benefits, Case histories.

Seven case histories of leak detection in towns located in the semiarid western U.S. are given. In the first case, an average daily use of 1500 gal per person indicated that losses were occurring. Investigations showed that 33% of the raw water supply was leaking into a stream, and another 17% was being lost from the distribution system. In case 2, an old lead joint pipe had 21 leaks, which lost 50% of a town's water supply during a drought. In the third case, metering located a crushed pipeline leaking 4 mgd or 20% of a Utah city's supply into a river. Repair of 23 large meters in the fourth example increased an Idaho city's water revenue by $100,000 per year at a cost of $5000 in repairs. In a Colorado city, the fifth example, 55% of meters were broken or inaccurate, not accounting for 18-43% of the water metered into the system. In case 6, metering an entire city reduced waste by 30%, and leak detection located 32 leaks. In the last case, malfunctions and leaky valves were causing losses. (Cassar-FRC)
W82-04375

BENEFITS FROM WATER CONSERVATION DEPEND ON COMPREHENSIVE PLANNING,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
W. J. Maier, J. DeZellar, and R. M. Miller.
Water Resources Bulletin, Vol 17 No 4, p 672-677, 1981. 2 Fig, 8 Tab, 12 Ref. OWRT B-139-MINN. 14-34-0001-8092.

Descriptors: *Water use, *Water conservation, Wastewater treatment, *Water treatment facilities, Water demand, Drought, Pollution load, Costs.

Experiences during the 1976-77 drought in California indicated that substantial savings in water consumption can be achieved under emergency conditions, resulting in some problems in wastewater treatment plants. In contrast, planned water conservation can be engineered to provide maximum monetary benefits when conservation programs coincide with increased populations to be saved. Fortunately, the self-cleaning hydraulic characteristics of circular channels, such as sewers, are relatively insensitive to flow over a wide range, reducing the problems caused by increased residence time. A computerized model study of effects of effluent flow reduction in a conventional municipal wastewater treatment plant indicated that the total BOD load discharged to receiving waters to reduced in direct proportion tothe flow reduction. The higher influent concentrations were compensated by increased residence time in the plant. The effects on suspended solids are similar. Treatment plant operating costs are relatively insensitive to hydraulic loading, resulting in an increase per unit volume of sewage treated. The net effect, however, is a decrease in per capita customer charges. (Baker-FRC)
W82-04557

REDUCING THE FLUSH,
Building Research Establishment, Watford (England).
C. J. D. Webster, and P. J. Davidson.
Water, No 42, p 12-16, 1981. 5 Fig, 3 Ref.

Descriptors: *Flushing, *Water conservation, Domestic water, Domestic wastes, *Toilets, Wastewater, Design criteria, Great Britain.

Efforts are underway to reduce the amount of water used in dwellings and elsewhere for domestic purposes. The flushing of water closets (WCs) is estimated to account for up to 20% of the total public water supply although complexities may be involved in obtaining optimum savings from this area. Current pans used in the United Kingdom are designed to operate on a 9 liter flush, as there has been little incentive until now to design for a lower volume. In the absence of immediately available WCs using reduced flush volumes, the use of dual flush systems is an immediate strategy which both follows the normal replacement approach and depends on the user's mode of operation for its saving. The dual flush principle has been available for a long time, giving the user the option of about 4-5 liters or the full 9 liters. All trials have reported substantial water savings. Controlled flush cisterns are arranged so that flushing terminates as soon as the handle is released. In dwellings where there is a metered water supply there is some financial incentive to the householders to install a new system. It is thought to be possible to design a suite that will perform acceptably at three liters or a little more, and that such suites can be used in most drainage installations, subject to certain restrictions. Changes in urinal structure are also discussed. (Baker-FRC)
W82-04654

THE TRADITIONAL APPROACH TO WATER LOSS,
Thames Water Authority (England).
J. S. Pocock.
Water, No 42, p 43-44, 1982.

Descriptors: *Water loss, *Water supply development, Water demand, Water management, *Pipelines, Leakage, *Water conservation, Design standards.

At intervals of about every 30 years an apparent interest in water losses has surfaced. The need for better materials and better standards of design was recognized at a very early stage. Detailed regulations regarding the customers' fittings and pipework were introduced in 1871. Recently the institution of consumer protection policies has done away with the threat of retribution wherein water supplies could be shut off in cases of uncontrolled water waste in London. One of the earliest means of assessing the effectiveness of a system of waste control was that of comparing the total consumption in different towns on a per capita basis. A remarkable correlation was found between the demand growth rates of four British towns, and it was concluded that at any time within that period an effective waste control policy would have had a significant impact on the capital program of the organization. The financial return derived from an increase of effort in waste control can vary widely from place to place in an authority's area, perhaps by a factor of as much as 20. (Baker-FRC)
W82-04656

A MULTIVARIATE ANALYSIS OF MUNICIPAL WATER USE IN UTAH,
Utah State Univ., Logan.
R. D. Hansen.
PhD Thesis, 1981. 102 p, 14 Fig, 18 Tab, 32 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-20713.

Descriptors: *Water use, *Multivariate analysis, *Municipal water, *Model studies, Water supply, Drought, Groundwater, Surface water, *Utah.

This work formulates two multivariate models for the study of municipal water systems: (1) a monthly time series model for use in analyzing water use and (2) an additive logit model for analyzing water system response to drought. Both models are applied to Utah data. The time series regression model is used to study water demands in the Salt Lake City Water Department (SLCWD), Ogden City, and Granger-Hunter Improvement District service areas. The research shows that real price, as well as three weather/climate variables--average temperature, total precipitation, and daylight hours (percent)--has a significant impact on water usage in Utah. The usefulness of a monthly time series model for examining water management options is demonstrated. A hypothetical peak-season pricing scheme is examined. The characteristics of municipal systems which restricted water usage during the 1976-77 drought are studied using a logit model. This model specifies that the natural logarithm of the odds in favor of a municipal system having restrictions is a function of the size of the system, the percentage of individual connections served by separate outdoor systems, and the variability of the water supply. It is found that systems which rely heavily on surface water supplies were more vulnerable to drought conditions that those using groundwater or a combination of sources. The larger systems had a higher propensity for using restriction during the drought, as did those systems without separate pressure irrigation. (Sinha-OEIS)
W82-04728

3E. Conservation In Industry

STATUS AND PROBLEMS OF PROCESS WATER SUPPLY IN THE FRUIT AND VEGETABLE PROCESSING INDUSTRY (SITUATION UND AUFGABEN DER BETRIEBSWASSERWIRTSCHAFT IN DER OBST- UND GEMUSEVERARBEITENDEN INDUSTRIE),
M. Henkel, and M. Richter.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 358-359, 1981. 3 Fig, 2 Tab. (No English summary).

Descriptors: *Industrial water, *Food processing industry, *Water management, Water reuse, Fruit crops, Vegetable crops, Process water, Water conservation, Effluents, Wastewater discharge, Economic aspects, Social aspects, Water use.

A survey of 56 representative fruit and vegetable processing plants in the German Democratic Republic revealed that the status of water management in these industries is generally unsatisfactory. Considerable differences in quantities of water consumed per unit finished product were found even within the individual branches (product groups) of fruit juice, canned products, frozen products, fresh products, jams and jellies, and baby foods. Water supply becomes especially problematic for these firms when dry periods coincide with the start of the busy season. Only about half of the plants queried had information on their wastewater discharges, and most of these determined only degradable/filterable substances and pH. Of the approximately 50% of the plants surveyed which discharged their wastewaters directly into receiving streams, only 46% had even mechanical treatment plants, and 39% had to pay discharge fees. The responsibility of plant managers for water management is clearly outlined in East German law. Suggestions for improving the currently unsatisfactory situation included metering, increasing the consciousness of employees regarding water conservation, inclusion of water specialists in plant planning, and increasing research programs for specific industries. A few instances of successful water conservation projects are listed, including addition of condensate from fruit juice concentration to the transport water, recycling water from autoclaves and pasteurizers, recycling raw fruit wash water, and other in-plant reuse. (Carroll-FRC)
W82-04584

3F. Conservation In Agriculture

A CONCEPTUAL FRAMEWORK FOR EVALUATING AGRICULTURAL WATER CONSERVATION POTENTIALS,
California Univ. Davis. Dept. of Land, Air, and Water Resources.
D. C. Davenport, and R. M. Hagan.
Water Resources Bulletin, Vol 16, No 4, p 717-723, August, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Water losses, *Agricultural, *Evapotranspiration, *Water conservation, Methodology, Irrigation efficiency, Runoff, Subsurface runoff, Evaporation, Water reuse, Water quality, Water management, Water use efficiency, Seepage control.

Types of water losses in agriculture are defined and potential conservation measures outlined. Recoverable water remains on or below the land surface and includes seepage, leakage, spills, surface runoff and percolation below the root zone. Water is irrecoverably lost by evaporation from soil or water bodies and by transpiration from plants. The largest potential for water conservation is in reducing irrecoverable losses. Possible methods include reducing the ratio of open water surface to total volume in ponds and reservoirs, using groundwater storage via recharge ponds, applying evaporation supressants to surfaces of water bodies, irrigating at night, using drip irrigation and mulches, growing shorter season crops or varieties, reducing the cropped area and the acreage of phreatophytes, using deficit irrigation, withholding water at nonsensitive growth stages, applying foliar antitranspirants, adjusting planting dates to avoid high evapotranspiration periods, changing row direction and plant spacing to alter solar and advected energy, and controlling weeds. Recoverable water losses may be managed by recovery and reuse of water, reducing further losses, and intercepting water before it reaches the sea and becomes unusable. Advantages and disadvantages of reducing recoverable and irrecoverable losses by these methods are discussed. (Cassar-FRC)
W82-04251

IRRIGATION PRACTICES FOR RECLAIMED ALKALI SOILS,
Central Soil Salinity Research Inst., Karnal (India). Div. of Engineering.
V. V. D. Narayana, and N. K. Tyagi.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 400-406, December, 1981. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Irrigation efficiency, *Border irrigation, *Crop production, *Alkaline soils, Irrigation practices, Contour irrigation, Crop yield, Rice, Wheat, Mathematical studies, Slopes, Grading, *India.

Field experiments were carried out in India to compare irrigation efficiency on graded and level borders, determine the stream cutoff point, and determine the optimum border dimensions and see how sloping borders could be adopted for rice or wheat cultivation on alkali soils. With the prevailing gentle land slope of 0.1-0.2% as the border grade, wheat and rice can be grown in a layout of graded and closed borders in rotation. Light and frequent irrigations may be applied by cutting off irrigation once it has advanced to 70% of the border length. Irrigation efficiencies in small fields which are common in the Indo-Gangetic alluvial plains may be enhanced by using graded borders with lengths ranging from 50 to 70 m and widths from 6 to 8 m. These graded borders may also be used for growing rice during the rainy season by dividing them into two or three compartments connected by asbestos pipes. The rice yield estimates for a sloping border layout in two or three compartments are 65.4 and 67.7 quintals/ha, respectively. (Geiger-FRC)
W82-04269

EVALUATING DIRECT BENEFIT ESTIMATION PROCEDURES FOR IRRIGATION PROJECTS: A SIMPLIFIED APPROACH,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W82-04287

DIMENSIONLESS STREAM ADVANCE IN SLOPING BORDERS,
Science and Education Administration, Phoenix, AZ. Conservation Lab.
T. Strelkoff, and A. J. Clemmens.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 361-382, December, 1981. 18 Fig, 6 Ref.

Descriptors: *Mathematical studies, *Infiltration, *Mathematical models, *Border irrigation, Irrigation, Stream banks, Graphical methods, Streambeds, Rrunoff, Model studies, Recession curve.

A simple case of general stream border advance contains a plane border of great length and a constant inflowing discharge prior to cutoff. The advance curve is controlled by border slope, roughness, infiltration, and inflow discharge and cutoff time. If the advanced function is viewed in dimensionless terms, the number of controlling parameters is significantly reduced. If only advance prior to inflow cutoff is of interest, then two dimensionless parameters govern the dimensionless advance curves. Methods of applying kinematic-wave theory to the computation of border-irrigation flow proved simpler than the zero-inertia analysis employed for the general case. Using a dimensionless boundary value as a pertinent controlling variable increased the number of dimensionless governing parameters to three. Difficulty in representing a three-parameter family of advance curves was overcome by using normal depth as the characteristic depth and equating the dimensionless parameter for bed slope to one. Curves were given representing all practical cases of advance of an irrigation stream over a plane border with inflow that is constant prior to cutoff. (Geiger-FRC)
W82-04308

SUBSURFACE TRICKLE IRRIGATION MANGEMENT WITH MULTIPLE CROPPING,
Department of Agriculture, Phoenix, Arizona, Water Conservation Laboratory.
D. A. Bucks, L. J. Erie, O. F. French, F. S. Nakayama, and W. D. Pew.
Transactions of the ASAE, Vol 24, No 6, p 1482-1489, November/December, 1981. 6 Fig, 5 Tab, 17 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Evapotranspiration, *Trickle irrigation, Subsurface irrigation, Surface irrigation, Cultivation, Cantaloupes, Onions, Carrots, Productivity, Planting management, Soil-water-plant relationships.

Subsurface trickle irrigation with multiple cropping and minimum cultivation had many advantages over surface trickle irrigation: minimal interference with field operations, continuous production of two or more row crops without replacement of trickle lines, and extension of the useful life of a trickle system over a larger production base. Spring and Fall cantaloupes were grown on a clay loam soil with moderately saline water in 1977, 1978; dry onion and carrots in spring 1979; and fall cantaloupe in 1979. Cantaloupe yield was higher with weekly than with daily trickle irrigation; onion yield was higher with daily irrigation. Carrot yields were not affected by irrigation frequency. Production was highest at water application rates equal to or slightly higher than the seasonal evapotranspiration values for furrow irrigation. Maximum cantaloupe production was obtained with an average evapotranspiration of 51 cm for the spring crop and 39 for the fall crop. Seasonal evapotranspiration values for trickle irrigated onions and carrots were 56 cm and 41 cm, respectively. Roots of these plants did not clog the subsurface irrigation lines. (Cassar-FRC)
W82-04356

ENERGY, WATER, AND COST TRADE-OFFS IN IRRIGATION SYSTEM SELECTION AND MANAGEMENT,
California Univ., Davis.
R. M. Hagan, and E. B. Roberts.
Transactions of the ASAE, Vol 24, No 6, p 1539-1545, November/December, 1981. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Energy, *Cost analysis, *Irrigation efficiency, Water requirements, Irrigation design, Management, Surface irrigation, Sprinkler irrigation, Furrow irrigation, Electric power, Pumping, Peak demand, Water costs.

Energy, water, and cost tradeoffs were examined in detail for 28 variations of irrigation system design and operation. These included sprinkler irrigation (hand-move, wheel-line, four types of center-pivot, and two types of lateral-move) and furrow irrigation (four types of graded and two types of level). The assumed crop was cotton growing in the San Joaquin Valley on very fine sandy loam soil. Both inexpensive, low energy water and expensive, high energy water were considered. Changes made to conserve water either increased or decreased annual energy requirements and annual costs. No single system provided the lowest energy requirements, water requirements, and costs. A guide is given to determine the feasibility of shifting irrigation pumping away from peak electrical use hours. It considers the water supply capacity, irrigation system capacity, and other factors such as labor and capital costs. Suggestions are given for modifying systems if changes are feasible. (Cassar-FRC)
W82-04360

SUNFLOWER YIELD VS. WATER DEFICITS IN MAJOR GROWTH PERIODS,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2I.
W82-04361

DEEP TILLAGE OF IRRIGATED PULLMAN CLAY LOAM--A LONG-TERM EVALUATION,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 2G.
W82-04372

SOIL AND WATER REGIMES FOR OPTIMUM AND FOR MAXIMUM YIELDS,
South Dakota State Univ., Brookings. Water Resources Inst.
L. O. Fine, and J. D. McLeod.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211483, Price codes: A03 in paper copy, A01 in microfiche. Completion Report December, 1981. 32 p, 17 Fig, 6 Tab, 4 Ref. OWRT A-068-SDAK. 14-4-0001-8044.

Descriptors: *Water use efficiency, Soybeans, *Irrigation efficiency, *Crop production, *Soil-water-plant relationships, *Cost-benefit analysis, Corn, Sorghum, *Great Plains.

Rapidly increasing demands on usable water resources, and escalating energy costs, with virtually stable or falling farm commodity prices have resulted in production pressures and cost-price squeeze situations for agriculture, particularly irrigated agriculture, in the corn-soybean-sorghum areas of the Great Plains. Actual out-of-pocket pmping costs have doubled or tripled in 4-6 years in most areas, and are projected to double again in the next 8-10 years. These circumstances are especially important to the irrigator with high lifts or in an area of especially high energy costs. The situation described makes it essential that the irrigator know, for each crop, the time of most critical water need by that crop, the amount to supply, and the nature of the water supply-yield response curve, so that he can manage his water supply to the best advantage. If two or more crops need water simultaneously and his water supply or funds available are limited, he needs to make a decision as to which crop to water and suffer the least economic loss. For more than three decades, information has been available on the consumptive use: total, seasonal distribution of need and critical periods of need of water by corn. The results of most investigations in the northern Great Plains point to a peak period of maximum daily use corresponding with the grand period of growth through tasseling-silking. Some studies agree on the critical nature of the tassel-silk brown stage for maximum yield impact. Because of the above quite well established information for corn, it was felt that a more productive study area would be the water regimes most profitable and productive for soybeans.
W82-04415

WATER MOVEMENT FACTORS IMPORTANT TO THE DESIGN AND OPERATION OF SUBIRRIGATION SYSTEMS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs.
Transactions of the ASAE, Vol 24, No 6, p 1553-1561, November/December, 1981. 11 Fig, 1 Tab, 23 Ref.

Descriptors: *Irrigation design, *Drain spacing, *Subsurface irrigation, *Soil water movement, Design criteria, *Drainage systems, Soil properties, Water table fluctuations, Model studies.

Design of subirrigation and drainage systems depends on soil properties, crop, and climate. Movement in these systems is lateral from a drain or open ditch (saturated flow) and vertical in the zone above the water table (unsaturated flow). Three operational modes are considered in design of a subirrigation system. (1) Steady state--the drains should be spaced to maintain the desired water table depth range during long periods of high evapotranspiration. (2) Transient state--the system should be designed to manipulate the water table as desired in case of operator error, equipment failure, or low levels at the beginning of the growing season. (3) Subirrigation under changing weather conditions--the operation of the system in both deficient and excessive rainfall periods should be considered. Methods are given for calculating the position and shape of the water table during steady state and transient subirrigation. Use of the water management model, DRAINMOD, for operation of a subirrigation system under changing weather conditions is discussed. A drainage system is developed for a 110 acre field of sandy loam underlain by sandy clay loam near Farmville, North Carolina. Optimum drainage spacing is 18 m for subirrigation-drainage and 25 m for conventional drainage alone. (Cassar-FRC)
W82-04538

WATER USE EFFICIENCY AND ROTATIONAL WATER SUPPLY AT THE FARM LEVEL: CERTAIN RESULTS FROM AN EXPERIMENTAL PILOT PROJECT IN GUJARAT STATE, INDIA,
Mahi-Kadana Irrigation Project, Ahmedabad (India).
T. K. Jayaraman.
Water Supply and Management, Vol 5, No 6, p 391-399, 1981. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Irrigation efficiency, *Water use efficiency, Rotational irrigation, Irrigation practices, *India, Agriculture, Water management, Social aspects, Economic aspects, Vegetable crops.

Pilot studies (1976-1980) in the 557 ha Mahi-Kadana project, India, showed that rotational irrigation in the rabi season increased water use efficiency to 69% the season the method was introduced and 72% after the system was stabilized. Water use efficiency in the 2 years before rotational irrigation were 41% and 59%. The total number of rrigated acres increased 9% after rotational irrigation. Cropping intensity also increased from 57-78% during the control years to 85% under rotational irrigation. The total water drawn from November to March averaged 532.70 and 569.76 cusecs in the control years and 530.76 and 509.19 cusecs in the rotational irrigation years. A survey of farmers after the project was completed showed that owners of both large- and small-size holdings supported the program. Quarreling over water supplies and worry about receiving water on time had been eliminated. (Cassar-FRC)
W82-04608

NOTE ON PUDDLING EFFECTS ON WATER FLOW THROUGH SOILS,
Punjab Agricultural Univ., Ludhiana (India).
For primary bibliographic entry see Field 2G.
W82-04671

ENERGY AND WATER CONSERVATION STRATEGIES IN IRRIGATED AGRICULTURE,
California Univ., Berkeley. Lawrence Berkeley Lab.
R. L. Ritschard, and K. Tsao.
Water Resources Bulletin, Bulletin, Vol 16, No 2, p 340-347, April, 1980. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Water conservation, *Drought, *California, *Irrigation practices, Irrigation, Farming, Water supply, Water management, Energy, Energy conservation.

Conservation strategies applicable to California are considered in the light of the drought of 1976 and 1977. These strategies include increased use of ground water, increased irrigation efficiencies, and shifts in cropping patterns. These modifications lessened the losses due to the drought. However, some of these changes may have caused problems for future water supply, for example the extensive pumping of ground water supplies and ground subsidence. Changes in irrigation practices may have affected the salt balance for future years. Maintaining and augmenting surface water supply, increasing power use efficiencies, and improving irrigation efficiencies are viewed as potential conservation strategies for that region. Electricity savings associated with water conservation have been estimated to be as much as 25%. Specific near term actions suggested for facilitating conservation include an expanded irrigation management system, efficient water deliveries, and a continued effort on the part of individual growers to use resources during periods of normal rainfall as they were used under drought conditions. (Baker-FRC)
W82-04736

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

YOUNG'S INEQUALITY FOR THREE-DIMENSIONAL FLOWS,
Public Power Corp., Athens (Greece). Computing Center.
For primary bibliographic entry see Field 2A.
W82-04267

SIMPLE EQUATIONS FOR HOOGHOUDT EQUIVALENT DEPTH,
Democritos Univ. of Thraki, Xanthi (Greece). School of Engineering.
J. G. Sakkas, and V. Z. Antonopoulos.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 411-414, December, 1981. 1 Tab, 4 Ref.

Descriptors: *Hydrologic models, *Design criteria, *Tile drainage, *Mathematical equations, Mathematical studies, Drainage, Drain spacing, Drainage practices, Drainage engineering, Drains, Mathematical models.

The Hooghoudt equation for drainage design problems has been reworked and simplified by other researchers to include dimensionless variables. Unique nomographic solutions for the equivalent depth and drain spacing formulas may be used in conjunction with elaborate computer prorams to solve transient flow problems. For faster estima-

tions of the equivalent depth which avoid storage of a table in the computer memory, approximate fomulas have been developed which may be reworked into simple algebraic expressions. A series of values for the drain spacing function was used to fit three curves to the data by the least squares method. The relative error using these solutions was dependent upon the radius of the tile drains. The simplified formulas show no appreciable loss of accuracy and may be used to compute the equivalent depth for steady or unsteady state drainage problems with a desk calculator or digital computer. (Geiger-FRC)
W82-04271

WILL NEW ORLEANS MISS THE MISSISSIPPI,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. G. Kazmann.
Journal of the American Water Works Association, Vol 73, No 11, p 18, 20, November, 1981. 1 Fig.

Descriptors: *Saline water intrusion, *Disasters, *Water supply development, *New Orleans, Louisiana, *Mississippi River, *Atchafalaya River, Municipal water, Rivers, Flood damage, Flood control, Old River Control Complex, Conjunctive use, Water resources development, Water management, Injection wells, Alternative planning, Potential water supply, Water control.

Cities with water supplies vulnerable to natural disasters should plan alternate means of obtaining water. New Orleans faces the possibility of losing Mississippi River flow to an alternate distributary, the Atchafalaya River. Throughout the early 20th century an increasing proportion of river flow entered the Atchafalaya, reaching greater than 30% by 1954. The Old River Control Complex was built at the point where the Atchafalaya and the main stem are closest, near Simmesport. This structure consists of a spillway and an overland structure to assist during floods. The Atchafalaya channel continued to deepen and build a higher flood plain in the lower basin. The 1973 flood greatly weakened the control structure. If this is destroyed by a future flood, 70% of the river flow would be diverted through the Atchafalaya. Although navigation in the New Orleans area would not be affected, the Mississippi River water could become saline, unusable for drinking or industrial purposes. A proposed scheme to provide water to the city under these circumstances is conjunctive use of groundwater and water from the Pearl River. A treatment plant would inject filtered surplus river water into a well field, prventing land subsidence from excess groundwater withdrawals. Although the Corps of Engineers claims that the Mississippi River can be kept in its present course indefinitely, the author suggests that an alternate supply must be established for New Orleans before a catastrophe occurs. (Cassar-FRC)
W82-04274

DETENTION BASINS--AN URBAN EXPERIENCE,
Georgia Inst. of Tech., Atlanta.
T. N. Debo, and H. Ruby.
Public Works, Vol 113, No 1, p 42-43, 93-94, January, 1982.

Descriptors: *Flood control, *Detention reservoirs, *Urban drainage, Maintenance, Safety, Retention basins, Basins, *Atlanta, Georgia, Runoff, Evaluation.

Detention basins, encouraged for runoff control in the Atlanta, Georgia, metropolitan area, also produce problems. These include maintenance problems and health and safety problems. Detention basins do not effectively control flooding in all situations. Sometimes all the drainage is concentrated in one drainage channel. The combined effects of several detention basins may change the timing of flood discharges so that higher peak flows will occur than would have occurred under natural conditions. The many swimming pool-sized detention basins have little effect on downstream flooding. Erosion may also be increased. Detention basins designed for a 100-year flood have little flood control effect on a 5- or 10-year storm. Costs assessments of detention basins should consider loss of valuable land for building, esthetics, and loss of tax revenue. A survey of residents living near 15 small detention basins showed that 68% said no water accumulated in the basins, 12% felt the basins decreased flooding problems, and 5% felt drainage problems were aggravated. Over 70% did not realize that adjacent property owners were responsible for maintenance. A survey of engineers indicated that many basins were not functioning as planned and that only basins in developments of 20 acres or more had a major positive flood control effect. (Cassar-FRC)
W82-04332

ESTIMATION OF EXTREME LOW FLOWS FOR PUMPED STORAGE RESERVOIR DESIGN,
Newcastle upon Tyne Univ., (England). Dept. of Engineering Mathematics.
For primary bibliographic entry see Field 2E.
W82-04334

PUMPED OUTLETS FOR DRAINAGE SYSTEMS,
For primary bibliographic entry see Field 8A.
W82-04364

ANALYSIS OF DETENTION BASIN SYSTEMS,
Monash Univ., Clayton (Australia).
For primary bibliographic entry see Field 2A.
W82-04444

PREDICTION OF WATER INFLOW TO LAKE MEMPHREMAGOG (PREVISION DES APPORTS HYDRIQUES AU LAC MEMPHREMAGOG),
Ministere de l'Environnement, Sainte-Foy (Quebec). Service des Eaux de Surface.
For primary bibliographic entry see Field 2A.
W82-04459

DETERMINATION AND REPRESENTATION OF THE STORAGE EFFECT (ZUR ERMITTLUNG UND DARSTELLUNG DER SPEICHERWIRKUNG),
Technische Univ., Dresden (German D.R.).
S. Dyck.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 331-335, 1981. 9 Fig, 10 Ref. (No English Summary).

Descriptors: *Reservoirs, *Water storage, *Planning, Design criteria, Management planning, *Reservoir operation, Flow control, Reservoir releases, Water demand.

Storage reservoirs, as important components of water management systems, must be carefully designed and operated. The general flow equalization goal of storage reservoirs, either in terms of constant release throughout the year or of demand-based release, must be achieved with the smallest possible storage volume. The most important factors influencing the selection of storage volume are the distribution function of the inflow (coefficient of variation and skewness), the determination interval, the long-term and short-term persistence characteristics of the inflow series, the demand or release function, the operation or balancing time, the initial level of the reservoir, and the simulation model of the experimental method. The simple autoregression model or Markov model is generally superior to the fractional noise model. For annual determination intervals, series of at least 1000 data runs are required in order to assure 99% reliability of coverage of the demand with the selected storage volume. Optimal reservoir operating plans, in terms of maximal compensation of the flow variations, were developed using the 'rule of clamped thread', i.e., a process for calculating the shortest path through a corridor of irregular shape. the inherent unpredictability of future inflows emphasizes the great significance of large data series, especially in the case of smaller reservoirs. (Carroll-FRC)
W82-04576

MONEY DOWN THE DRAIN,
Hydraulics Research Station, Wallingford (England).
P. Colyer.
Water, No 42, p 6-9, 1982. 2 Fig.

Descriptors: *Urban drainage, *Economic aspects, Computers, Automation, *Design criteria, Management, Construction, Water management, Drainage, Storm drains, *Urban runoff.

Due to the great expense involved in urban drainage networks, it is imperative that the system be efficient, well founded and accurate regarding design, construction and management. The Wallingford Procedure is a set of computer programs and accompanying reports which embody the latest recommendations on urban storm drainage. It is based on research started in 1974 at the Hydraulics Research Station, the Institute of Hydrology and the Meteorological Office. The Procedure presented four alternative methods. One is appropriate for design work only, one for analysis only and two for both design and analysis. The Modified Rational method is based on the long-established principles of the Rational method, calculating peak runoff discharge only. The Optimising method determines flows from the Modified Rational method but a minimum cost design is produced. The Hydrograph method includes the full modelling procedure for surface runoff and free surface pipe or channel flow. The simulation method includes all the main features of the Hydrograph method and also extends to surcharge analysis and surface flooding. Flapped outfalls can also be represented. The computer package is available from the Hydraulics Research Station. (Baker-FRC)
W82-04653

FORECASTING CHANGES OF WATER RESOURCES IN LARGE RIVERS FOLLOWING LAND DRAINAGE,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 2A.
W82-04721

SIMULATED INTERACTIONS BETWEEN THE PROPOSED NARROWS RESERVOIR AND THE WATER-TABLE AQUIFER ALONG THE SOUTH PLATTE RIVER, MORGAN COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-04725

DEMAND SIGNALS FOR URBAN DRAINAGE AND FLOOD CONTROL PROJECTS,
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 6A.
W82-04737

4B. Groundwater Management

SOIL PERCOLATION RATES FROM NEUTRON PROBE MEASUREMENTS,
Oregon State Univ., Corvallis.
T. S. Vinson, and L. Mahar.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 343-359, December, 1981. 14 Fig, 3 Tab, 31 Ref.

Descriptors: *Groundwater movement, *Groundwater management, *Moisture probe, Spray irrigation, Percolation, Moisture meters, Moisture profiles, Soil columns, Moisture content, Irrigation water.

Studies were conducted to assess the feasibility of using subsurface neutron moisture probes to estimate soil percolation rates as part of a long-term research project to determine hydrologic conditions at a spray irrigation facility. The new technique utilizes the soil moisture content in relation

to time obtained at two levels in a soil column or profile in which one-dimensional percolation is taking place. The procedure was validated in laboratory percolation tests using 10 columns filled with well graded sand. The calculated quantities of water during these trials agreed well with the actual amounts of water collected from each column. The procedure is simpler than traditional percolation rate tests, but its validity for layered soil profiles or shallow groundwater table conditions has yet to be ascertained. When performing in situ measurements using the neutron moisture probes, consideration should be given to the method of installation of the access tube, the time intervals at which moisture contents will be recorded at each site, the distance between levels where moisture content values are taken, and the depth from the ground surface to the level where moisture content readings are recorded. (Geiger-FRC)
W82-04309

THE RESPONSE OF GROUNDWATER TO ARTIFICIAL RECHARGE SCHEMES,
Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopoulos.
Water Resources Research, Vol 17, No 6, p 1712-1714, December, 1981. 3 Fig, 3 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Aquifers, Mathematical studies, Groundwater movement, Recharge, *Groundwater management, Unconfined aquifers, Groundwater storage, Transmissivity, Seasonal variation.

Analytical solutions for the groundwater flow in an unconfined aquifer showed that uniform recharge rates over the whole period of recharge are not the optimal solution. A greater net gain (up to 24%) in aquifer storage and outflow can be obtained by distributing the recharge volume over several periods of variable duration. Artificial recharge can be scheduled, knowing the effects of seasonal variations in infiltration. (Cassar-FRC)
W82-04337

HYDROLOGIC EFFECTS FROM CHANGES IN GROUND WATER PUMPAGE,
International Engineering Co., Incorp., San Francisco, CA.
For primary bibliographic entry see Field 2F.
W82-04428

A LUMPED APPROACH TO THE INVERSE PROBLEM IN GROUND WATER HYDROLOGY,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 16, No 5, p 866-873, October, 1980. 5 Fig, 23 Ref.

Descriptors: *Groundwater, *Geohydrology, Groundwater hydrology, *Model studies, *Groundwater movement, Computers, Hydrologic models, Simulation, Water resources development, Water supply development.

A solution for the inverse problem in groundwater has been proposed, based on the lumped approach. For the purpose of illustrating the solution procedure, a hypothetical aquifer having impermeable boundaries was considered. Of primary concern was the demonstration of the validity of the approach and the observance of the convergence characteristics of the search algorithm. The aquifer is unconfined, having uniform depth of 100 ft, overlying a horizontal impermeable bed. It is 8000 feet wide and 12,000 feet long and has five pumping wells of various capacities. The inverse model uses a simulation model and approximate boundary conditions to generate values for surrogate permeabilities such that the model output agrees reasonably with the observed data. The emphasis is on the determination not of the conventional aquifer permeability, but of a surrogate permeability, so that the model can eventually be used for the management studies. The surrogate permeability should not be interpreted as a property of the porous media. It is simply a transformation constant in the management model. The advantage of such an approach is that the system complexities that are hard to determine essentially become incorporated into the surrogate parameters. The proposed method also allows the same ground water flow equations and the same solution procedure with the same initial and boundary conditions to be employed both in the identification process and in the subsequent management studies. This tends to minimize errors inherent in a simulation process. (Baker-FRC)
W82-04451

TWO-DIMENSIONAL GROUND-WATER FLOW MODEL OF THE CRETACEOUS AQUIFER SYSTEM OF LEE COUNTY AND VICINITY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04492

BOREHOLE DATA-COLLECTION METHODS APPLICABLE FOR THE REGIONAL OBSERVATION AND MONITOR WELL PROGRAM, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. J. Hickey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-133448, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-57, 1981. 10 p, 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Borehole geophysics, *Groundwater, *Water management, *Data collections, Aquifers, Observation wells, Monitoring, Geohydrology, Carbonate rates, Water quality, Water level, *Florida, *Floridan aquifer.

Management of ground-water resources within the Southwest Florida Water Management District requires that hydrogeologic characteristics of water-bearing rocks and quality characteristics of water be described. Wells for the District's Regional Observation and Monitor Well Program are drilled specifically to collect data to describe the groundwater resource. Suggested borehole data-collection methods for these wells include drilling in stages; running geophysical logs at the completion of each stage; collection of water-level and specific-conductance data before, during, and after a day's drilling; specific-capacity determinations after a day's drilling; and placing a packer in the gypsiferous and anhydritic limestone and dolomite for water-level and water-quality data. (USGS)
W82-04493

EFFECT OF IRRIGATION PUMPING ON THE GROUND-WATER SYSTEM IN NEWTON AND JASPER COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
M. P. Bergeron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-137688, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-38, August, 1981. 73 p, 33 Fig, 7 Tab, 25 Ref.

Descriptors: *Groundwater, *Irrigation, *Pumping, *Surface-groundwater relations, Groundwater movement, Model studies, Simulation analysis, Aquifers, Aquifer characteristics, Bedrock, Water level fluctuation, Drawdown, Glacial drift, *Groundwater mining, Groundwater recharge, *Indiana, Newton County, Jasper County, Hydraulic conductivity.

Flow in the ground-water system in Newton and Jasper Counties, Indiana, was simulated in a quasi-three-dimensional model in a study of irrigation use of ground water in the two counties. The ground-water system consists of three aquifers: (1) a surficial coarse sand aquifer known as the Kankakee aquifer, (2) a limestone and dolomite bedrock aquifer, and (3) a sand and gravel bedrock valley aquifer. Irrigation pumping, derived primarily from the bedrock, was estimated to be 34.8 million gallons per day during peak irrigation in 1977. Acreage irrigated with ground water is estimated to be 6,200 acres. A series of model experiments was used to estimate the effects of irrigation pumping on ground-water levels and streamflow. Model analysis indicates that a major factor controlling drawdown due to pumping in the bedrock aquifer are the variations in thickness and in vertical hydraulic conductivity in a semiconfining unit overlying the bedrock. Streamflow was not significantly reduced by hypothetical withdrawals of 12.6 million gallons per day from the bedrock aquifer and 10.3 million gallons per day in the Kankakee aquifer. Simulation of water-level recovery after irrigation pumping indicated that a 5-year period of alternating between increasing pumping and recovery will not cause serious problems of residual drawdown or ground-water mining. (USGS)
W82-04497

GEOHYDROLOGIC RECONNAISSANCE OF THE CROFTON UNIT, NORTHEASTERN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
S. J. Kent, R. A Engberg, and M. J. Ellis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-129115, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-58, 1981. 34 p, 14 Fig, 5 Tab, 15 Ref.

Descriptors: *Groundwater, *Water quality, *Geohydrology, *Groundwater availability, Water table, Irrigation wells, Water yield, Sampling, Water analysis, *Nebraska, *Crofton unit.

This report describes sources, locations, quantity, and quality of ground water in a 350-square-mile area whose potential for irrigation development is being evaluated by the U.S. Bureau of Reclamation. The entire area is underlain by Precambrian Sioux Quartzite, which throughout most of the area is overlain by undifferentiated Paleozoic rocks. The Sioux and, where present, Paleozoic rocks are overlain unconformably by Cretaceous formations, including the Dakota and Niobrara Formations. Surface strata are Pleistocene and Holocene deposits of sand and gravel and Pleistocene glacial till. The Dakota and Niobrara Formations are each capable of yielding water sufficient for irrigation wells in parts of the area. Pleistocene and Holocene deposits yield adequate water for irrigation in the southern part of the area and along the flood plain of the Missouri River. Water from the Dakota Formation is so saline as to necessitate burdensome salinity-control measures for successful long-term irrigation use. That from the Niobrara Formation is suitable for irrigation of most crops. Water from Pleistocene and Holocene deposits is highly variable, but is suitable for irrigation in the southern part of the area and along the Missouri River. (USGS)
W82-04498

ROADS IN WATER-PROCURING REGIONS - WATER POLLUTION CONTROL AND SAFEGUARDING OF WATER SUPPLY, EXEMPLIFIED BY THE STUTTGART-SINGEN AUTOBAHN (STRASSEN IN WASSERGEWINNUNGSGEBIETEN- GEWASSERSCHUTZ UND SICHERSTELLUNG DER WASSERVERSORGUNG AM BEISPIEL DER AUTOBAHN A 81 STUTTGART-SINGEN),
Tubingen Regierungspresidium (Germany, F.R.).
H. Bartel.
Wasserwirtschaft, Vol 71, No 11, p 313-318, November, 1981. 4 Fig, 3 Ref. English summary.

Descriptors: *Road construction, *Watershed protection, *Karst hydrology, Aquifers, *Groundwater protection, *Germany, Runoff, Construction materials, Costs, Turbidity, Oil spills, Water treatment, Impervious boundaries, Imported water, Water pollution control, Erosion control, Geology.

Water supply is a major government objective in the State of Baden-Wurttemburg, since available

groundwater reserves are concentrated in limited areas, while the remainder of the territory has inadequate local supplies. A major international highway, Autobahn A81, is under construction in this State. The vulnerability of the groundwater in the karstic formations is intensified by highway construction and anticipated petroleum pollution. In highway planning, important water-bearing formations were circumvented insofar as possible, but collecting regions are traversed over a distance of 24 km. Water protection plans were developed cooperatively by highway engineers, water supply planners and geologists. Where the clay marl layer generally overlying the karst was lacking, a special impermeable layer was applied in preparation of the roadbed. Piping was installed to divert highway runoff to suitable infiltration areas with oil protection. Fissures and cavities exposed during construction were also sealed with impermeable materials such as clay or cement. Protection costs were estimated at 9.6 million German Marks. Water supply security was simultaneously improved by installing additional filtration and biological equipment in affected water supply plants. Where the protection offered by these measures was judged inadequate, provisions were made for permanent or emergency water important. (Carroll-FRC)
W82-04551

LOCAL IRRIGATION AGENCIES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Revesz, and D. H. Marks.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 329-338, October, 1981. 1 Tab, 10 Ref. OWRT 14-34-0001-9430.

Descriptors: *Irrigation districts, *Conjunctive use, *Water management, Model studies, Water policy, Water law, Local governments, Water distribution, Water management, Public policy, Water districts, Groundwater management, Institutions, Legal aspects, Planning.

The history and nature of irrigation institutions in the U.S. are described. Mathematical models of irrigation supplies assume that comprehensive irrigation management exists. In reality, the three major types of irrigation agencies (public irrigation disricts, mutual water companies, and commerical water companies) have limited power. With few exceptions, they have no direct control over groundwater depletion. Public irrigation districts are most powerful, followed by mutual companies, then by commerical water companies (which have virtually disappeared). Conjunctive use modelers should rely only on those decision variables controlled by the particular agency under study. (Cassar-FRC)
W82-04560

GROUNDWATER CONTROL,
King's Coll., London (England). Dept. of Civil Engineering.
J. K. White.
Civil Engineering (London), p 27, 29-31, December, 1981. 10 Fig.

Descriptors: *Construction methods, *Groundwater management, Unconfined aquifers, Confined aquifers, Dewatering, Groundwater level, *Excavation, Urbanization, Industrial development, *Coastal areas, Estuaries, *Water table.

Urban and industrial development occurring near rivers, coastal areas and estuaries where the water table is closest to the ground surface frequently calls for control of groundwater to be undertaken. Two types of control are considered. The first occurs when a foundation excavation goes below the water table in a saturated permeable material, such as gravel or sand, which lies above a substantial impermeable base. The second type of situation occurs when the excavation is in a relatively dry impermeable strata, which is near the surface but which overlies a saturated permeable material in which the water pressure would cause the water level in a stand pipe located in it to rise above the formation level of the foundation. Under these circumstances there is the risk that removal of the excavating material will cause sufficient imbalance between overburden and water pressure for the water to break through and flood the excavation. The method of control adopted will vary and depends on the circumstances. While experience plays a large and essential part in the specification of a dewatering system, there has been a growing demand in recent years for analytical justification for design. Models have been devised which are used to give more reliable estimates of well point performance when used in conjunction with sheet pile cut-offs in those cases where both the system and the cut-off partially penetrate an unconfined aquifer. (Baker-FRC)
W82-04714

4C. Effects On Water Of Man's Non-Water Activities

EVALUATION OF METHODS FOR DETERMINING URBAN RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
W. J. Rawls, A. Shalaby, and R. H. McCuen.
Transactions of the ASAE, Vol 24, No 6, p 1562-1566, November/December, 1981. 3 Fig, 5 Tab, 11 Ref.

Descriptors: *Urban runoff, *Hydrologic models, *Land use, Urban hydrology, Soil types, Rainfall-runoff relationships, Antecedent moisture, Soil water, Runoff curve number.

The runoff curve number, an important input parameter to the Soil Conservation Service's hydrologic models, integrates land cover, soil type, and antecedent soil moisture conditions. Data from 175 urban watersheds were used to determine runoff curve number by three methods: the contingency table approach (measuring the fractions of land use and soils separately and integrating them with a weighted average scheme), use of the U.S. Geological Survey land use maps, and the conventional approach (use of the overlay method with low altitude aerial photos, land use maps, and onsite investigations). Results indicated that estimates of runoff curve numbers were sensitive to the land use classification system and relatively insensitive to the method of integrating soils and land cover data. The detailed, time-consuming conventional approach was not necessary for watersheds of greater than 26 sq km. A set of runoff curve numbers was calculated for the three hydrologic soil groups for Level II U.S. Geological Survey land use categories. Although these were not in total agreement with those estimated by the conventional approach, the level of imprecision was considered satisfactory for most hydrologic studies. (Cassar-FRC)
W82-04535

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME I, STATE-OF-THE-ART REPORT,
Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, and N. P. Kobriger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241895, Price codes: A06 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/042, February, 1981. 121 p, 16 Fig, 37 Tab, 169 Ref. DOT-FH-11-8600.

Descriptors: *Highways, *Roads, *Water pollution sources, *Storm runoff, *Urban runoff, Drainage effects, Particulate matter, Deicers, *Highway effects, Environmental effects, Heavy metals, Pesticides, Oxygen demand, Salt.

The factors which most affect quantity and quality of highway runoff are traffic volume, rainfall intensity and pattern, highway drainage characteristics, operation and maintenance characteristics and degree of imperviousness of the drainage area. Maintenance of adequate drainage is one of the most important aspects of highway design. Highway runoff characteristics are similar to those of urban runoff and may exert significant shock pollutional loads on receiving waters. The weighted average of total solids accumulations between successive street cleanings, a period of 2 to 12 days, for eight cities was found to be 1400 lb/curb mile. A high percentage of street surface pollutants are associated with very fine dust and dirt particles. Substantial quantities of toxic materials, such as heavy metals and pesticides, are present in street surface contaminants with the amounts varying considerably from site to site. Because of the consistent presence of heavy metals in amounts large enough to interfere with BOD5 measurements, COD is considered to be a better parameter for measuring the oxygen demand potential of highway runoff. Highway salting rates usually range from 400 to 1200 lbs per two-lane mile. Over the winter season, a typical multiple lane highway may use 100 tons or more of salt per mile. Significant amounts of vehicle released airborne matter are settled out and washed off the road surface during rainstorms. (Moore-SRC)
W82-04627

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME II, PROCEDURAL MANUAL FOR MONITORING OF HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5A.
W82-04628

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME III, PREDICTIVE PROCEDURE FOR DETERMINING POLLUTION CHARACTERISTICS IN HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04629

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME V, HIGHWAY RUNOFF DATA STORAGE PROGRAM AND COMPUTER USER'S MANUAL,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04630

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME IV, CHARACTERISTICS OF HIGHWAY RUNOFF FROM OPERATING HIGHWAYS. RESEARCH REPORT,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04637

A DIMENSIONLESS UNIT HYDROGRAPH FOR URBANIZING CATCHMENT AREAS,
Sir William Halcrow and Partners, London (England).
For primary bibliographic entry see Field 2A.
W82-04683

PRESCRIBED FIRE: EFFECTS ON WATER QUALITY AND FOREST NUTRIENT CYCLE,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
D. D. Richter, C. W. Ralston, and W. R. Harms.
Science, Vol 215, No 4533, p 661-663, February 5, 1982. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Forest management, *Water quality, Cycling nutrients, Phosphorus, Sodium, Nitrogen, Carbon, Calcium, Magnesium, Water pollution sources, Groundwater, Forest soils, Hydrology, Nutrients, *Forest fires, Environmental effects, Runoff.

This report examines both off-site and on-site effects of a series of prescribed fires on experimental watersheds in the Lower Coastal Plain of South Carolina. Studies of off-site effects were concerned with fire-caused exports of materials from a pine forest ecosystem to drainage waters and the atmosphere, while on-site effects focused on the magnitude and extent of hydrologic fluxes of nutrients from burned litter to mineral soils and ground waters. Hydrologic nutrient fluxes from burned

forest floors were evaluated from the nutrient contents of litter samples collected immediately after the fire and again after postburn rainfall of about 15 cm. The contents of total nitrogen, phosphorus and sulfur in burned forest floors were not significantly changed by the initial rainfall. Analysis of mineral soil collections before fire and after fire and rain indicated minor effects of fires on mineral soil chemical properties, despite variations in fire intensities and in postburn leaching conditions. The changes in total mineral soil carbon, nitrogen and phosphorus were small. No fire effects were observed on specific conductance, pH, or dissolved concentrations of ammonium, nitrates, phosphates, sulfates, chlorides, calcium, magnesium, potassium or sodium in ground waters collected from surface soil and subsoil horizons. No changes were noted in the chemical constituents of streams which could be attributed to the fire treatment. (Baker-FRC)
W82-04690

GROUNDWATER CONTROL,
King's Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W82-04714

4D. Watershed Protection

PONDING SURFACE DRAINAGE WATER FOR SEDIMENT AND PHOSPHORUS REMOVAL,
Snake River Conservation Research Center, Kimberly, ID.
M. J. Brown, J. A. Bondurant, and C. E. Brockway.
Transactions of the ASAE, Vol 24, No 6, p 1478-1481, November/December, 1981. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Sedimentation basins, *Phosphorus removal, *Agricultural runoff, Irrigation, Drainage water, Surface drainage, Ponds, Sediment control, Suspended sediment, Water pollution control, Erosion control, Runoff, Idaho, Sediment removal.

A 3400 cu m sediment retention pond receiving surface water runoff from 4050 ha of irrigated land in Idaho removed sediment and phosphorus at greater than design efficiency (50% of total sediment input) for the 5-year observation period, 1972-1976. Removal efficiencies were 65-76% for sediment and 25-33% for total P. Phosphorus passing through this pond was either soluble or attached to soil particles too small to settle without flocculation. Average daily flow through the pond during the irrigation runoff period, April-November, was 347 liters per sec, and average retention time was 2.7 hours. Removal efficiency generally increased with increasing flow rate. A stream flow of 340-453 liters per sec removed sediment most efficiently. Very high flow rates did not allow even silt particles to settle. Optimum sediment concentration was 20-750 mg per liter. (Cassar-FRC)
W82-04358

TOPSOIL MANAGEMENT OF MINED SOILS,
Science and Education Administration, Cheyenne, WY.
G. E. Schuman, and J. F. Power.
Journal of Soil and Water Conservation, Vol 36, No 2, March/April p 77-78, 1981. 23 Ref.

Descriptors: *Land reclamation, *Topsoil, *Resources management, *Strip mine wastes, *Strip mines, Soil management, Soil properties, Crop yield, Runoff, Infiltration, Watershed protection.

Federal and state laws require that strip mined land be reclaimed to a level of productivity equal to or greater than that which existed before the mining. Topsoil must be removed before the mining operation and redistributed over the graded overburden after the coal has been removed. Studies on necessary topsoil depth found maximum grass yields with a subsoil depth of 28 inches and a topsoil depth of 8 inches. Another study found topsoil depths of 8 and 16 inches to give good yields. Topsoil plays a major role in water infiltration; infiltration increases with topsoil depth. Some studies have found that the major portion of a root system is limited to the topsoil. Forage grown on reclaimed mine areas is generally of lower quality than that grown on adjacent land. This may be a result of topsoil stockpiling which causes shifts in soil fungal dominants and the loss of other microorganisms. In general, topsoil provides a good rooting medium, improves infiltration, reduces runoff, and encourages faster establishment of nutrient cycles. It also usually increases the species diversity of vegetational cover. (Small-FRC)
W82-04571

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATING MEDIUMS AND PLATING TECHNIQUES FOR ENUMERATING BACTERIA IN WATER DISTRIBUTION SYSTEMS,
Southern California Metropolitan Water District, LaVerne.
E. G. Means, L. Hanami, H. F. Ridgway, and B. H. Olson.
Journal of the American Water Works Association, Vol 73, No 11, p 585-590, November, 1981. 1 Fig, 7 Tab, 13 Ref.

Descriptors: *Bacterial analysis, *Culture media, Microbiological studies, Chlorination, *Drinking water, Water distribution, Membrane filtration, *Pollutant identification, Water analysis, Agar, Unchlorinated water, Comparison studies.

Media and plating techniques for bacterial enumeration were evaluated using 2 drinking waters, one chlorinated surface water and the other unchlorinated groundwater. Samples were collected bimonthly from June 1978 to September 1979. Media were plate count agar, R-2A low nutrient agar, and m-standard plate count agar. Incubation temperatures were either 20 or 35 C. The techniques were spread plate, pour plate, and membrane filtration. The m-standard plate count medium with membrane filtration recovered bacterial from the water systems most efficiently. The spread plate technique was better than the pour plate technique for counting the total and pigmented bacteria in both waters. The different media tended to select for particular subpopulations. There were also discrepancies in bacteria recovery efficiencies between the chlorinated and unchlorinated waters. In view of this evidence the pour plate method should be replaced with alternative methods for enumerating bacteria in water distribution systems. (Cassar-FRC)
W82-04277

EVALUATING STREAM STANDARD VIOLATIONS USING A WATER QUALITY DATA BASE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, and R. C. Ward.
Water Resources Bulletin, Vol 17, No 6, p 1071-1078, December, 1981. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Standards, *Water quality, *Variability, Effluent standards, Monitoring, Sampling, Model studies, Regulations, *Pollutant identification, Seasonal variation, Streams, *Sangamon River, *Illinois, Dissolved oxygen, Specific conductivity.

Two models (normal and nonparametric) for the behavior of a water quality random variable are reviewed. These models gave similar results when used with a water quality data base to describe the past behavior of a water quality variable relative to a stream standard and to evaluate apparent changes in the frequency of standard violations. They help to determine whether violations of standards are a result of natural variability or quality degradation. Cumulative density functions for water quality random variables were estimated using data from a routine grab sampling program, then were used to estimate the probability that a single grab sample will violate a given stream standard and to determine the anticipated number of violations in a given number of samples. Confidence limits about a point on the cumulative density function may be used to reflect the accuracy with which the sample estimate represents the true cumulative density function. The procedure, intended for use by state regulatory agencies, was illustrated using specific conductance and dissolved oxygen in the Sangamon River, Illinois. (Cassar-FRC)
W82-04286

PHOSPHORUS AVAILABILITY IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-04324

RESPONSES OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. II. PURE CULTURE VS. MIXED CULTURE RESPONSE,
Texas Univ. at Austin. School of Public Health.
For primary bibliographic entry see Field 5C.
W82-04341

RESPONSE OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. I. RESPONSE OF BACTERIAL INDICATORS VS. RESPONSE OF PATHOGENIC BACTERIAL SPECIES,
Ife Univ. (Nigeria). Dept. of Environmental Health.
For primary bibliographic entry see Field 5C.
W82-04342

ANALYTICAL QUALITY CONTROL,
For primary bibliographic entry see Field 5G.
W82-04345

HEALTH ASPECTS OF WATERS AT PUBLIC HEALTH RESORTS,
National Inst. for Water Research, Pretoria (South Africa).
E. M. Nupen, and J. S. Burger.
Water SA, Vol 7, No 4, p 216-222, October, 1981. 4 Tab, 23 Ref.

Descriptors: *Swimming pools, *Microbiological studies, *Disinfection, Pollutant identification, Water treatment, Recreation facilities, Water quality, Public health, Bacteria, Coliforms, *South Africa, Chlorination, Drinking water, Mineral water.

Drinking waters, mineral waters, rheumatic treatment bath waters, and recreational hot and cold swimming pool waters in seven South African resorts were examined microbiologically. No viruses were isolated from recreational or drinking waters. Candida albicans was found in only 1 sample. Bacterial counts of most waters did not exceed accepted limits. Chlorine was effective as a disinfectant. It is suggested that drinking waters at resorts be monitored constantly and that children's swimming pools should have their own filtration-disinfection system. (Cassar-FRC)
W82-04348

DETERMINATION OF VOLATILE ORGANICS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
California Analytical Lab., Sacramento.
J. L. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-119090, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-071, December, 1981. 7 p, 5 Tab. 68-03-2033.

Descriptors: *Wastewater analysis, *Volatile organic compounds, *Gas chromatography, Electron capture gas chomatography, Industrial wastewater,

Municipal wastewater, Sample preservation, Halogenated hydrocarbon, *Organic compounds, Volatility.

Methodologies for the analysis of volatile organic compounds in industrial and municipal wastewater were developed and evaluated, using gas chromatography (GC) with flame ionization, electron capture, and Coulson detectors. Although no single GC column was found that gives complete chromatographic separation of all 36 of the test compounds, several packing materials were identified that provide good separation of all but a few compounds. All the test compounds were detected by one or more of the analytical approaches studied at levels of 1 ppb or less. The nonhalogenated compounds were not detected by Coulson or electron capture. Many of the compounds are detectable at levels of 0.1 ppb or lower. The addition of preservatives to reduce residual chlorine in aqueous samples was found to help maintain the chemical stability of the samples. The major limitation of all the analytical approaches investigated was the lack of specificity of detection. The flame ionization detector was the only detector that was able to detect the nonhalogenated compounds. However, it was the least specific of the detectors studied. For relatively clean wastewaters, a combination of the analytical methods was found to usually be both specific and sensitive. For grossly polluted wastewaters, interferences became such a severe problem that qualitative identification was not feasible. (Moore-SRC)
W82-04396

DETERMINATION OF HALOETHERS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Monsanto Research Corp., Dayton, OH.
P. L. Sherman, J. M. Kyne, R. C. Gable, J. V. Pustinger, and C. R. McMillin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-123290, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-062, December, 1981. 5 p, 1 Fig, 4 Tab. 68-03-2033

Descriptors: *Haloethers, *Wastewater analysis, *Gas chromatography, *Chlorinated hydrocarbons, Municipal wastewater, Industrial wastewater, Ethers, Chemical analysis, Water analysis, Sample preservation.

The following haloethers were originally included in this study: 2-chloroethyl vinyl ether, bis(2-chloroisopropyl) ether, bis(2-chloroethyl) ether, bis(2-chloroethoxy) methane, 4-chlorophenyl phenyl ether, and bis(chloromethyl) ether. The 2-chloroethyl vinyl ether and bis(chloromethyl) ether were later deleted from the project because of extreme volatility and hydrolytic instability, respectively. A literature search was conducted to acquire published information on the hydrolytic stability of the haloethers, methods for the detection of haloethers in water, and methods for the isolation, concentration and analysis of haloethers. The workable method developed in this program for the analysis of haloethers in wastewater consisted of a liquid/liquid evaporators, a column chromatographic clean-up procedure using Florisil, another K-D evaporation of the fraction from the Florisil column, and subsequent analysis by gas chromatography using an electrolytic conductivity detector. Sample preservation was studied at various pH and residual chlorine levels and different temperatures. The stability of haloethers stored in acetone and in methanol was observed. (Moore-SRC)
W82-04398

SEWAGE SLUDGE PATHOGEN TRANSPORT MODEL PROJECT,
BDM Corp., Albuquerque, NM.
J. F. Dawson, K. E. Hain, B. McClure, R. E. Sheridan, and J. G. Yeager.
Environmental Protection Agency Project Summary EPA-600/S1-81-049, October, 1981. 5 p, 1 Fig.

Descriptors: *Computer models, *Pathogens, *Parasites, *Bacteria, *Viruses, *Sludge disposal, Wastewater treatment, Enteroviruses, Salmonella, Poliovirus, Ascaris, Mathematical models, Public health, Simulation, Fate of pollutants.

A computer model was developed to predict the numbers of specific pathogens that would be found in sewage sludge at various points during sludge treatment and application, along 13 defined pathways. These pathways describe the use of dried or liquid, raw or anaerobically digested sludge as a cropland fertilizer, dried raw sludge as an animal feed supplement, and composted sludge as a residential soil amendment. Three organisms were selected to represent the enteric pathogens most commonly found in sludge: Salmonella species were used to represent the bacteria; Ascaris species were used to represent parasites; and polioviruses were used to represent all enteric viruses. The model uses a compartment-vector approach in which a mathematical state represents a discrete point in a treatment or application pathway where pathogen populations are computed as a function of time. Within these compartments, mathematical process functions describe population changes due to environmental factors. Pathogen exchanges between compartments are described by transfer functions. The model permits user specification of various parameters in both process and transfer functions, for simulation of a unique set of environmental conditions. The model has the additional capability of performing exposure risk calculations for environmental compartments specified by the model user at the time of model variable initialization. (Moore-SRC)
W82-04403

EVALUATION OF ELECTROMAGNETIC TERRAIN CONDUCTIVITY MEASUREMENTS FOR DETECTION AND MAPPING OF SALT-WATER INTERFACES IN COASTAL AQUIFERS.
University of South Florida, Tampa. Dept. of Geology.
T. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211459, Price codes: A04 in paper copy, A01 in microfiche. Publication No 60, September, 1981. 57 p, 27 Fig, 2 Tab, 28 Ref. OWRT A-043-FLA(1). 14-34-0001-1110.

Descriptors: *Remote sensing, *Geophysical surveys, Saltwater interfaces, Coastal aquifers, *Saline-freshwater interfaces, Electromagnetic waves, Conductivity, Measuring instruments.

In coastal areas salt-water intrusion represents a significant threat to water quality in coastal aquifer systems. The electromagnetic method evaluated in this study proved to be rapid, very inexpensive, and it yields results which agree well with geologic and geochemical surveys using direct sampling. The instrument reads directly in conductivity units, and the depth of investigation is constant for a particular spacing and orientation of the receiver and transmitter coils. Data can be obtained and interpreted by personnel with little technical training. Data interpretation normally involves contouring terrain conductivity maps, but quantitative solutions can be obtained where the geoelectric section can be reasonable approximated by a two-layer section. Some problems were experienced with interference. However interference sources usually were very localized and could be avoided. This study in two areas of Florida demonstrates that the EM conductivity method is very useful for rapid, inexpensive ground water surveys where the objective is to locate zones of conductive pore fluids at depths less than 30-40 meters. Although interpretation is indirect and qualitative, neither data aquisition nor interpretation require special training. This characteristic of the EM method makes it very suitable for use by agencies where highly-trained technical personnel are not available.
W82-04412

THE IDENTIFICATION AND TREATMENT OF BROMIDES AND TRIHALOMETHANES IN POTABLE WATER FROM THE PEARL RIVER AT JACKSON, MS: EVALUATION OF TOXICITY ON SPECIES DIVERSITY,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
G. D. Barnes, B. S. Dhillon, and A. S. Hume.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211467, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, December, 1981. 70 p, 20 Fig, 18 Tab, 48 Ref. OWRT B-028-MS(1). 14-34-0001-1239.

Descriptors: *Water pollution, *Trihalomethanes, Silver bromide, Silver bromate, *Bromides, Potassium bromide, Species diversity, Mean numbers of organisms, Community composition, Zooplankton, Decay rates of trihalomethanes, *Phytoplankton, Toxicity, Water treatment, Potable water, *Pearl River, *Jackson, Mississippi, Daphnia, Cyclops.

Significant differences in a completely randomized block design were found in species diversity (d) and mean numbers of phytoplankton in microcosms by the following treatments when compared to a control: total trihalomethane levels (1, 10, 1000 and 100,000 ppb); potassium bromide levels (1, 10 and 1000 ppb); silver bromide levels (1, 10, 1000, 10,000 and 100,000 ppb) and silver bromate (1, 10 and 1000 ppb). Toxic threshold levels for algae were between the two highest levels in THM and silver bromide respectively. Daphnia sp. and Cyclops sp. mortality increased with increasing levels of treatments: total trihalomethanes (1, 10, 100 and 1000 ppb); silver bromides (1, 10, 1000 and 10,000); silver bromates (1, 10, 1000 and 10,000). The high level of silver bromate was extremely toxic in both experiments to Daphnia and Cyclops. Percent decay rates for chloroform, bromodichloromethane, chlorodibromomethane and bromoform were similar at all time intervals throughout the study. By 11.3 hrs., approximately fifty percent of all the trihalomethanes were depleted from the microcosms. From computer projected decay rates, chloroform and bromoform were depleted from the microcosms by 80 hrs.
W82-04413

DEVELOPMENT OF THE FECAL STREPTOCOCCUS GROUP AND ITS INDIVIDUAL SPECIES AS WATER QUALITY INDICATORS,
Northern Arizona Univ., Flagstaff. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W82-04416

MEMBRANE FILTER METHOD FOR ENUMERATION OF ACINETOBACTER CALCOACETICUS FROM ENVIRONMENTAL WATERS,
Rhode Island Univ., Kinston. Dept. of Microbiology.
S. J. LaCroix, and V. J. Cabelli.
Applied and Environmental Microbiology, Vol 43, No 1, p 90-96, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Membrane processes, *Bacteria, Ponds, Filtration, *Bacterial analysis, Separation techniques, Lakes, Nutrients, Microbiological studies, Acinetobacter calcoaceticus, Pathogenic bacteria, Pollutant identification.

The aim of this study was to develop a selective-differential procedure for the quantification of Acinetobacter calcoaceticus as the first step in better defining the ecology of the organism. The procedure developed uses a mineral medium, with sodium acetate and potassium nitrate as the carbon and nitrogen sources, respectively. The recovery of A. calcoaceticus was enhanced through the introduction of formic acid, which also inhibited background growth. After incubation at 30 degrees C for 46 hr, fermentation and cytochrome oxidase tests were performed on the colonies as they appeared on the membrane. Background microbial growth decreased on the average by 1.77 orders of magnitude. An essentially quantitative recovery relative to that on nutrient agar spread plates was obtained from freshly prepared suspensions of eight A. calcoaceticus strains in filter sterilized pond water at 15 and 22 degrees C. With the three remaining strains markedly reduced relative recoveries were obtained. However, these three strains, in contrast to the first five, not only did not grow,

but also decreased in number in the eutrophic, filter sterilized pond water. The confirmation rate of presumptive A. calcoaceticus colonies was 95%, whereas 8% of the presumptively negative colonies were A. calcoaceticus. Densities of A. calcoaceticus in freshwaters ranged from less than 1 to 79,000 organisms per 100 ml water and were about 1,000,000 organisms per 100 ml in raw sewage. (Baker-FRC)
W82-04453

A SIMPLE MICRODETERMINATION OF POLYMER FLOCCULANTS (POLYACRYLAMIDES AND GUAR) IN MINE WATER,
Anglo American Research Lab., Johannesburg (South Africa).
E. Jungreis.
Analytical Letters, Vol 14, No A14, p 1177-1183, 1981. 3 Tab, 8 Ref.

Descriptors: *Mine drainage, *Chemical analysis, Filtration, Membrane filters, Filters, Membrane processes, *Polymers, Guar, Polyacrylamides, Flocculation, *Wastewater analysis.

A method is presented for the microdetermination of polymer flocculants in mine water by measuring the laminar flow rate through a membrane filter under vacuum. The procedure calls for filtering the mine water sample through an 8.0 micrometer millipore filter, measuring the pH, and filtering 50 ml of this pretreated sample through a 0.22 micrometer 25 mm diameter millipore filter under vacuum. The filtration time is measured. A calibration graph is prepared at the same temperature, same pH, same vacuum conditions and the same filtering system, with freshly prepared polymer flocculant solution of the same kind. The concentration of the unknown is determined from the time-concentration plot. The precision of the method is acceptable. (Baker-FRC)
W82-04457

DETERMINATION OF TRACE INORGANIC POLLUTANTS (CU, PB, CD, ZN) IN WATERS BY DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY AT A ROTATING MERCURY FILM ELECTRODE (DOSAGE DE MICROPOLLUANTS MINERAUX DES EAUX (CU, PB, CD, ZN) PAR VOLTAMPEROMETRIE DE REDISSOLUTION ANODIQUE IMPULSIONNELLE SUR ELECTRODE TOURNANTE A FILM DE MERCURE),
Parisien Lab. Regional de l'Est, Le Bourget (France).
M. Bouzanne.
Analysis, Vol 9, No 10, p 461-467, December, 1981. 5 Fig, 11 Ref. English summary.

Descriptors: *Chemical analysis, *Water quality, *Heavy metals, Metals, Electrodes, Electrochemistry, Chemical interference, Dissolved oxygen, Natural waters, Copper, Lead, Cadmium, Zinc.

Various anodic stripping techniques seem promising for rapid, simple determination of trace inorganic pollutants, especially heavy metals, in natural waters. Differential pulse anodic stripping voltammetry using a preconcentrated phase is inherently more sensitive than direct electrochemical methods such as pulse polarography. A rapid deoxygenation apparatus was developed for use with this method, which was then applied for heavy metal determination in 500 samples of various natural waters. Operating conditions such as pulse duration, electrolysis potential, and final potential depend to some extent on the nature and concentration of the supporting electrolyte. The duration of electrolysis, electrode rotation speed, and measurement scale were adjusted after a preliminary tracing was obtained. Use of an internal standard is recommended rather than a calibration curve because of possible variations between samples due to the presence of traces of surfactants or dissolved oxygen and alterations in the mercury distribution. Interference due to the formation of intermetallic compounds in simultaneous determinations can be eliminated by addition of suitable reagents such as gallium and germanium salts. Prior oxidation with potassium persulfate or UV photolysis can eliminate interference by traces of dissolved organic compounds. At the microgram per liter level, the coefficient of variation for eight successive determinations of lead, cadmium and copper was 1-1.5%, depending on the element examined. For a reasonable electrolysis time of 15 min, detection limits of 10 ng/l were achieved for lead and 5 ng/l for copper and cadmium. (Carroll-FRC)
W82-04458

ENTEROTOXIGENIC BACTERIA IN FOOD AND WATER FROM AN ETHIOPIAN COMMUNITY,
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Bacteriology and Epizootology.
S. F. H. Jiwa, K. Krovacek, and T. Wadstrom.
Applied and Environmental Microbiology, Vol 41, No 4, p 1010-1019, April, 1981. 1 Fig, 5 Tab, 57 Ref.

Descriptors: *Pollutant identification, *Pathogenic bacteria, *Bacterial analysis, Water pollution, Developing countries, Enteric bacteria, E. coli, Isolation, Separation techniques, Human diseases, Coliforms, Foods, Public health, *Ethiopia.

Forty of 213 bacterial isolates from Ethiopian food and natural water samples were capable of producing heat-labile enterotoxin (LT). Among the LT-producers Escherichia coli, Enterobacter, Klebsiella, Serratia, and Proteus were present. Enterotoxigenic isolates from food included oxidase positive strains of Aeromonas, Pseudomonas, Achromobacter, Flavobacterium, and Vibrio. LT-enterotoxigenic species from food and water samples included Enterobacter, Acinetobacter, Klebsiella, Proteus, Providencia, and Serratia. Several isolates gave positive reactions in Chinese hamster ovary cell tests and induced fluid accumulation in rabbit ileal loops. After storage in trypticase soy broth with glycerol at -70 degrees C for 9 months, only about 33% of the oxidase-positive strains were still LT enterotoxigenic. None of the E. coli isolates possessed K88, K99 or colonization factor antigen. Although this study showed that food and water contained enterotoxigens of the same species as those isolated from infantile diarrhea cases, no correlations were made between these pathogens and the incidence of infantile diarrhea in developing countries. (Geiger-FRC)
W82-04463

INFLUENCE OF DILUENTS, MEDIA, AND MEMBRANE FILTERS ON DETECTION OF INJURED WATERBORNE COLIFORM BACTERIA,
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, S. C. Cameron, and M. W. LeChevallier.
Applied and Environmental Microbiology, Vol 43, No 1, p 97-103, 1982. 3 Fig, 2 Tab, 44 Ref.

Descriptors: *Bacteria, *Drinking water, Water analysis, Filtration, Membrane processes, Membranes, *Coliforms, Waterborne bacteria.

The recovery of coliforms both before and after substantial cellular injury in drinking water is examined with respect to the composition, exposure time, and temperature of the diluents; the composition of various media commonly used in water quality testing; and the surface pore morphology of membrane filters at 35 degrees C. Pure cultures of Escherichia coli, Klebsiella pneumoniae, Enterobacter aerogenes, and Citrobacter freundii were injured in water from a dead end section of the Bozeman, Montana, distribution system. The addition of peptone or milk solids to diluents and low temperatures of 4 degrees C maximized the recovery of injured cells but did not significantly affect undamaged cells. High efficiencies of recovery of control cells were noted on most media tested, but recoveries of injured cells ranged from 0 to nearly 100%. Less than 30% of the injured cells were recovered by most of the media commonly used in water analysis. This was done in part to the sensitivity of injured bacteria to deoxycholate concentrations greater than 0.01%, whereas control cells were unaffected by 0.1%. A negligible effect of membrane filter surface pore morphology on total coliform recoveries was noted at 35 degrees C. These findings support the development of new methodologies, allowing a more complete enumeration of injured coliforms in potable water and providing more accurate and dependable water quality information. (Baker-FRC)
W82-04469

OCCURRENCE AND FATE OF CERTAIN TRIPHENYLMETHANE BLUE DYESTUFFS IN THE AQUATIC ENVIRONMENT,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5B.
W82-04478

DETERMINATION OF TRACE ELEMENTS IN SEAWATER BY NEUTRON ACTIVATION ANALYSIS AND ELECTROCHEMICAL SEPARATION,
Oslo Univ. (Norway).
K. Jorstad, and B. Salbu.
Analytical Chemistry, Vol 52, No 4, p 672-676, April, 1980. 4 Fig, 4 Tab, 9 Ref.

Descriptors: *Trace elements, *Water analysis, *Neutron activation analysis, Electrochemistry, Chemical reactions, Heavy metals, *Seawater, Electrolysis, Separation techniques, *Pollutant identification, Water pollution, Radioactive tracers, Radioisotopes.

In order to reduce the respective disadvantages of the individual methods, neutron activation analysis has been combined with electrodeposition on a mercury electrode to concentrate traces of reducible metals, leaving interfering elements in solution. This combination provides a useful multielement method for the determination of 28 elements in seawater. Samples which have been freeze-dried and irradiated are dissolved in dilute nitric acid and electrolyzed for 1 hour. Silver, arsenic, gold, cadmium, cobalt, chromium, iron, mercury, gallium, lanthanum, molybdenum, antimony, selenium, and zinc can be determined from the radioactive species deposited on the mercury cathode. After a radioactive decay time of 2 weeks, the following 14 elements can be determined by measuring the activities in the residual solution: barium, bromine, calcium, cerium, cesium, europium, sodium, rubidium, scandium, samarium, strontium, thorium, uranium, and ytterbium. Since only radioactive species deposited on the cathode or left in the solution are being measured, technical grade reagents can be used. In order to obtain a reproducible electrolysis, radioactive tracers have been used to study the decrease of element concentrations in solution as a function of time of electrolysis, the influence of the initial element concentration on the rate constant K, the effect of cathode material, and the effect of the pH in solution. The technique may be used for multielement analysis of other samples having a high content of interfering elements which are not deposited on the electrode, such as samples of biological or geologic origin. (Carroll-FRC)
W82-04530

AUTOMATIC MEASURING STATION FOR CONTINUOUS MONITORING OF RIVERS,
Passavant-Werke Michelbacher Huette, Aarbergen (Germany, F.R.).
H. B. Kloppel.
Water Science and Technology, Vol 13, No 11/12, p 683-686, 1981. 1 Fig.

Descriptors: *Monitoring, *Water quality, *Automation, Computers, Water management, Rivers, Data acquisition, Data collections, Turbidity, Hydrogen ion concentration, Dissolved oxygen, Conductivity, Wastewater treatment, *Effluents.

A measuring station is described which was developed for the constant monitoring of rivers or water with similar characteristics. It is equipped for automatic cleaning and calibration and can be monitored remotely by means of an integrated computer via MODEM and telephone connection. The parameters for water temperature, pH, dissolved oxygen, conductivity and turbidity are measured. The computer collects the test data. It carries out preliminary data processing and stores the data

until it is called up by telephone. In addition the computer accepts the commands for controlling the station via to a telephone connection. It transfers the commands to the control unit of the station, and reports back the operating condition of the station via telephone. The station can also be operated as an independent functional unit without a computer, and as such can be used for monitoring the final effluent of a sewage treatment plant without much maintenance. The measured values are then transmitted separately via cable to the control center of the treatment plant itself. The measuring station is provided with very effectively operating equipment for the automatic cleaning and calibration of the sensors so that the station can operate without supervision for 4 weeks. (Baker-FRC)
W82-04569

WATER QUALITY MONITORING SYSTEM IN NIEDERSACHSEN - APPLICATION OF AUTOMATIC STATIONS FOR CONTROL AND MONITORING OF WATER QUALITY,
Niedersachsisches Wasseruntersuchungsamt, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W82-04575

CONTINUOUS MEASUREMENT OF ORGANIC SOLVENTS IN AIR AND WATER (KONTINUIERLICHE MESSUNG ORGANISCHER LOSEMITTEL IN LUFT UND WASSER),
Siegrist G.m.b.H., Hamburg (Germany, F.R.).
H. Fuhrmann.
Wasser, Luft und Betrieb, Vol 25, No 12, p 25-28. 1981. 8 Fig, 4 Ref. (No English Summary).

Descriptors: *Chemical analysis, *Solvents, *Measuring insruments, Industrial water, Indusrial wastewater, Organic compounds, Chemical industry, Separation techniques, Trace levels.

A flexible second generation measurement system was developed which can be applied to the measurement of organic solvents in air and water. The measurement principle is based on changes in the elecrical conductivity of heated gas semiconductors due to the presence of adsorbed reducing materials. Systems applicable to water include membrane-sensor systems immersed directly in the liquid to be measured and connected to the evaluation apparatus by cable; membrane systems immersed in the liquid to be measured, with continuous measurement provided by diffusion rate dilution with clean air, and continuously operating phase exchange systems with evaluation by gas sensors. The latter system avoids problems due to water contaminants in that only the volatile solvents are transferred into the gas phase. Range selection and calibration curves can be used to measure individual and total components. These instruments are particularly suitable for industrial applications. (Carroll-FRC)
W82-04579

CHLORIDE DETERMINATION IN AUTOMATED WATER COMPOSITION MONITORING (CHLORIDBESTIMMUNG IN DER AUTOMATISIERTEN WASSERBESCHAFFENHEITSKONTROLLE),
Institute fuer Wasserwirtschaft, Berlin (German D.R.).
H. Heitmann.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 341-342, 1981. 6 Ref. (No English Summary).

Descriptors: *Chlorides, *Chemical analysis, *Titration, Automation, Salinity, *Monitoring, Drinking water, Industrial water, River water, Saale River, *Elbe River, Potentiometry, Saline water intrusion, Germany.

Chloride levels in drinking water should not exceed 250 mg/l, since higher concentrations give a brackish taste. Chloride in industrial water corrodes iron, and chloride monitoring is also necessary as an indicator of saltwater intrusion. Possible methods of automated chloride monitoring include continuous potentiometric measurement of chloride ion activity with an ion-sensitive electrode and automated potentiometric titration of chloride ions with silver nitrate solutions. The former method is easier, but the latter method is more accurate, and therefore each of these methods is most suitable for specific applications. Use of continuous potentiometric chloride measurement is advantageous only where great accuracy is not required, for example for saltwater intrusion monitoring, so that an alarm can be sounded if a specific chloride level is exceeded. It is less useful for effluent monitoring because of possible interference by sulfide, bromide, iodide, cyanide and thiosulfate ions, as well as changes in the total salt content and temperature of the water. Automated electrode cleaning and calibration could improve accuracy beyont the presentplus or minus 15%. automated titration equipment is available which has a sample collection timing device. Mixing effects can introduce errors, especially in turbid samples, but can be controlled by slowing the rate of titration. Automated titration for determining the chloride input from the Saale into the Elbe iver over a number of years gave accuracy comparable to that of laboratory titration, (Carroll-FRC)
W82-04580

CONTINUOUS MONITORING OF THE EFFLUENT QUALITY OF AN ACTIVATED SLUDGE PLANT BY TURBIDITY MEASUREMENT (KONTINUIERLICHE KONTROLLE DER ABLAUFGUTE EINER BELEBTSCHLAMMANLAGE MITTELS TRUBUNGSMESSUNG),
Forschungszentrum Wassertechnik (German, D.R.).
K. Hanel, P. Liedke, W. Gutendort, and C. Anton.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 337-340, 1981. 5 Fig, 9 Ref. (No English summary).

Descriptors: *Activated sludge process, *Turbidity, *Process control, Sludge solids, Wastewater treatment facilities, Effluents, Sludge excess, *Monitoring, Automation, Measuring instruments.

The characteristics most frequently used for evaluating wastewater treatment effluent quality, such as BOD and filterable materials, are not suitable for rapid measurement, within a time period suitable for process control utilization. Other possible characteristics, such as chemical oxygen demand and total organic carbon, are not directly linked with the functioning of the activated sludge plant. Turbidity measurement has not been widely used for rapid estimation of effluent quality because of the difficulty of establishing a definite relationship between turbidity and other quality criteria in different waters. Sludge discharge was a frequent problem at the Wahren wastewater treatment plant. An attempt was made to monitor the occurrence of this phenomenon using a continuous light scattering turbidimeter, Nephelon II. Relatively close correlations were found between turbidity values, activated sludge content and BOD. Correlations were poor when large numbers of hydrophobic particulates were present following heavy rain and when incomplete biological purification was occurring, but errors were on the conservative side in these cases. If hydraulic conditions are favorable, measurements may be employed to control the operation of excess sludge pumps as long as safeguards against over-running are added. (Carroll-FRC)
W82-04583

UTILIZATION OF DATA FROM AUTOMATIC WATER QUALITY MONITORING STATIONS IN FINLAND,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 7B.
W82-04585

THE UNTERWESER AUTOMATIC WATER QUALITY MEASUREMENT SYSTEM,
H. Kunz.
Water Science and Technology, Vol 13, No 11/12, p 657-662, 1981. 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Water quality, *Monitoring, *Weser River, Germany, Data acquisition, Automation, Water management, Oxygen, Acidity, Powerplants, *Wastewater, Mixing, Tidal rivers, Heated water, *Nuclear powerplants, *Tidal effects.

This paper describes the requirements placed on the Unterweser nuclear power plant (KKU) measurement system, the technical configuration, experience and results. The nuclear power plant operator must control his plant so as to remain within specified limits. The water authority responsible requires proof of this and carries out checks on the plant. In addition to thee temperature, the oxygen content, the conductivity and to a limited extent the pH value are also calculated. The measuring stations in the Unterweser have been placed as far out into the deep navigation channel as shipping permits because this offers the best point for presenting the applicable water quality conditions. The measurement station only records the values and transmits them to a central station when polled by radio. The stationary KKU water quality measurement system has available a fast measurement vessel as well as two meteorological measuring stations. These systems can both collect and record data themselves as well as be integrated in the data flow controlled from the central station. In contrast to tidal-free waters, the water level as well as the flow rates periodically vary with the tide, and sea water flows in. One and the same body of water passes a discharge point several times and is thus charged with waste water many times. Waste water discharged into the river may be carried by the tidal flow far beyond the discharge point. This complicated transporting and mixing process demands sophisticated measuring equipment to obtain data needed for control, monitoring and securing evidence of falling quality. (Baker-FRC)
W82-04588

CONTINUOUS WATER QUALITY MONITORING SYSTEM USING TELEMETRY IN THE CITY OF OSAKA,
Japan Sewage Works Bureau, Osaka.
K. Nanbo, and R. Kunogi.
Water Science and Technology, Vol 13, No 11/12, p 639-644, 1981. 3 Fig, 1 Tab.

Descriptors: *Water quality, *Monitoring, *Automation, Telemetry, Computers, Data acquisition, *Osaka, *Japan, Networks, Performance evaluation, *Wastewater facilities.

This paper summarizes the monitoring system used for water quality control in the city of Osaka, Japan, and lists items of importance for ensuring that the system operates at maximum efficiency and provides exact data. The central monitoring system is connected with the river monitoring stations, the sewage treatment plant monitoring stations and the factory monitoring stations by telemetry and collects data from them. Nine river, three sewage, and six factory monitoring stations have already been installed, and plans exist for 1, 10, and 4 additional stations, respectively. The central monitoring station is connected with each river and sewage treatment plant monitoring station through an allotted communication circuit and with factory monitoring stations through the public communication circuit. Data are collected every 5 minutes from river stations, every hour from sewage treatment plant stations and every day from factory stations, by a polling system. Various kinds of instruments are installed for telemetry, data logger and input-output of data in the central monitoring station. Proper maintenance is indispensable to get the most efficient operation from the equipment. It is hoped that the information being gained will aid the establishment of automatic water quality monitoring systems. (Baker-FRC)
W82-04590

THE AUTOMATIC MEASURING OF SEWAGE IN THE ARTOIS-PICARDIE AREA,
Artois-Picardie Agence de l'Eau, Douai (France).
J. -M. Journet.
Water Science and Technology, Vol 13, No 11/12, p 619-624, 1981. 2 Fig.

Descriptors: *Water quality, *Monitoring, Wastewater treatment, Automation, Data acquisition, Water management, Effluents, *Water pollu-

tion sources, Watershed protection, Chemical analysis, Dissolved oxygen, Turbidity, *Waterways, *France.

In 1971 automatic monitoring of waterways was introduced into the Artois-Picardie area in northern France. This monitoring was found to be insufficient after a few years, and automatic monitoring of sewage was introduced. From 1975 on, two mobile stations were used to observe the natural conditions in the waterways of the catchment area and those affected by sewage pollution. The results showed the influence of nocturnal discharges from a cheese dairy upstream of the recording station on the quality of a small waterway. From 8 PM to 6 AM a significant increase of organic matter was noted, and a marked decrease in dissolved oxygen content. Subsequently an automatic Philips total oxygen demand meter and turbidimeters were tested on site with treated sewage and sewage containing industrial effluents. These were then included in the overall monitoring system in 1978 and 1979, with the building of four sewage monitoring stations. The results obtained by the end of 1980 concern 25 different types of discharge: paper mill, chemical, breweries, canning factories, iron and steel, domestic sewage and others. Plans for the future are briefly discussed. (Baker-FRC)
W82-04602

EVALUATION OF WATER QUALITY DATA RECEIVED BY AUTOMATIC CONTROL STATIONS AT THE TELTOW-CANAL IN BERLIN (WEST),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Chemieingenieurtechnik.
J. Schafer, H. Schumann, W. Niemitz, and U. Wiesmann.
Water Science and Technology, Vol 13, No 11/12, p 663-670, 1981. 7 Fig.

Descriptors: *Data collections, *Water quality, Automation, Monitoring, Canals, *Germany, *Teltow Canal, Berlin, *Effluents, Powerplants, Computers, Municipal sewage, Wastewater facilities.

The Teltow Canal is now one of the most heavily loaded waterways in Germany and contributes greatly to eutrophication of the lower Havel and the Havel lakes. This paper presents a first evaluation of water quality data from six automatic control stations along the canal. Mean values are given for each half year from 1972 through 1979 for concentrations of dissolved oxygen, temperature, conductivity and acidity. Changes in the distribution functions are given for diurnal mean values of oxygen concentration. A continuous degeneration of water quality over this time period was easily demonstrated. A special computer program was adapted to show the local and temporal changes in the data collected. Some of the results are presented as isolines for oxygen concentration and temperature. The increase in loading of the canal over the years was dramatic after the introduction of effluents from a new sewage treatment plant and another large power station. (Baker-FRC)
W82-04607

DETECTION AND MAPPING OF INSOLUBLE SINKING POLLUTANTS,
Rockwell International, Newbury Park, CA.
R. A. Meyer, M. Kirsch, and L. F. Marx.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105586, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-198, October, 1981. p, 5 Fig, 1 Tab. 68-03-2648.

Descriptors: *Water pollution, *Conductivity, *Acoustics, *Mapping, *Monitoring, *Hazardous materials, Carbon tetrachloride, Immiscibility, Solubility, Computers, Cleanup operations, Spills, *Pollutant identification.

Some of the hazardous materials spilled into rivers, streams, or lakes are immiscible, slightly soluble, and denser than water. These sinking pollutants must be detected at once, and their locations must be mapped to initiate cleanup operations and minimize impacts. An electrical conductivity monitoring system was developed to detect the rrival of sinking pollutants at the bottom of a watercourse. The submersible monitor uses a cyclically purged electrical conductivity probe capable of long-term deployment even when partially buried in sand or silt. The submersible unit, which is battery powered, will transmit the conductivity data to the shore-base receiver by means of ultrasonics. The unattended design life of the monitor is 1 year. A commercial 200-kHz depth-finder system has been extensively modified and tested for use in an underwater acoustic mapping system to locate pools when a spill of a sinking pollutant is known to have occurred. Laboratory tests indicate that the system is capable of resolving the echoes from the surface of a 1-cm deep layer of carbon tetrachloride from those returning from a hard, sandy, or muddy bottom. Field testing revealed few precursor echoes that might mask or interfere with the detection of an echo from a pollutant pool. Return echoes were evaluated by 16-mm motion picture photography, and a computer-based comparator-counter technique has been developed for data management. (Moore-SRC)
W82-04619

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME II, PROCEDURAL MANUAL FOR MONITORING OF HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, and T. L. Meinholz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241903, Price codes: A07 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/043, February, 1981. 121 p, 36 Fig, 9 Tab, 34 Ref, 3 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Water pollution sources, *Monitoring, *Runoff, *Water sampling, Flow measurement, Precipitation, Storm runoff, Land use, Site selection, *Highway effects, Environmental effects.

This manual has been prepared for use by highway department personnel to evaluate highway runoff. It contains detailed procedures for establishing and conducting a monitoring program and evaluating the collected data. There are a number of factors affecting the quality of the runoff that must be actively monitored for any site. Primary among these are traffic characteristics, highway operation and maintenance practices, precipitation characteristics, and the accumulation of pollutants on the highway. Other factors which must be noted because of their relevance to the quality of runoff include: adjacent land usage, right-of-way characteristics, roadway alinement, vertical plane, alinement of the highway, and pavement conditions. The steps required in establishing a successful monitoring program include: selection of a suitable site; planning a monitoring program; installing the monitoring equipment; maintenance and monitoring procedures; and evaluation and application of the results. A simple program may involve monitoring a single runoff event using manual sampling and flow monitoring techniques. A more complex program might involve monitoring events for an entire year or longer automated equipment. (Moore-SRC)
W82-04628

THE EFFECT OF STORAGE BY FREEZING ON DISSOLVED INORGANIC PHOSPHATE, NITRATE AND REACTIVE SILICATE FOR SAMPLES FROM COASTAL AND ESTUARINE WATERS,
Department of the Environment, Sidney (British Columbia). Inst. of Ocean Sciences.
R. W. Macdonald, and F. A. McLaughlin.
Water Research, Vol 16, No 1, p 95-104, January, 1982. 11 Fig, 4 Tab, 15 Ref.

Descriptors: *Sample preservation, *Nutrients, *Storage, Freezing, Silicates, Estuaries, Nitrates, Phosphates, Water sampling, Filtration, Thawing, Water analysis.

The effect of storage methods on stability of nutrients in coastal and estuarine waters was investigated. Parameters compared were freezing, quick freezing, filtering, and storage time. For phosphate, quick freezing produced better accuracy and precision in analysis. Filtration was necessary for turbid samples. Thaw time was not significant; storage time was significant for two of four samples, but examination of the data showed no clear trends. For nitrates, freezing was satisfactory; filtration was not necessary. Quick freezing slightly reduced the number of maverick samples. Freezing slightly decreased nitrate (1.6% for saline samples and zero for low salinity samples) and increased variance. Thaw time had no effects. In silicate determination, freezing was satisfactory for storage of saline water samples but not for low salinity estuarine samples, in which 5-15% of silicate was lost even after 24 hours that time. Quick freezing was better than regular freezing for the saline samples; filtering was not required. Samples should be analyzed for all three nutrients within two months after collection to limit variance caused by storage. (Cassar-FRC)
W82-04660

WATER QUALITY MONITORING - IDENTIFICATION OF RESIDENCE/TRAVELLING TIMES FROM HYDROLOGICAL AND WATER QUALITY INFORMATION,
Karlsruhe Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2E.
W82-04663

SURROGATE PARAMETER ANALYSIS FOR ORGANIC PRIORITY POLLUTANTS,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
C. E. Parker.
Journal Water Pollution Control Federation, Vol 54, No 1, p 77-86, January, 1982. 10 Fig, 33 Ref.

Descriptors: *Environmental effects, *Hazardous materials, *Toxins, Organic compounds, Wastewater, Water pollution sources, Bacteria, Cultures, Oxygen uptake, Adenosine triphosphatase, Pollutant identification, Water quality control.

In this paper the concept of using two microbial activities, adenosine triphosphate (ATP) and oxygen uptake, to quantify the strength of toxics in wastewater through a surrogate parameter is explored. Integrating short-term activity-time curves for various toxin concentrations and then correlating the activity-area curves with toxin concentration seem to be conceptually sound and offer one possible methodology for establishing a surrogate measurement of toxicity. The response of an ATP pool for a bacterial population to a toxic substance differs significantly from oxygen utilization. Because changes in the ATP pool are rapid and depend on the physiological state of the organism, standardization of the growth phase and of environmental conditions are essential. To eliminate the effect of the physiological state and to minimize fluctuations in the ATP pool, the ATP response to toxins is best measured during engogenous respiration and without substrate additions. The ATP activity response versus time for the endogenous culture could then reflect inhibition by the toxin. Toxins with the same activity-time response patterns may be quantified on the basis that equivalent areas represent short-term equivalent toxic effects. It has been shown that for several toxins the areas from activity-time plots for a bacterial culture can be related to toxin concentration. The ATP response is the more sensitive of the two activity measurements. Development of a bacterial bioassary procedure for surrogate toxin measurements will require the use of a pure culture. (Baker-FRC)
W82-04704

5B. Sources Of Pollution

WATER QUALITY PATTERNS DURING A STORM ON A MALL PARKING LOT,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
P. E. Black.

Water Resources Bulletin, Vol 16, No 4, p 615-620, August, 1980. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Urban runoff, *Nonpoint pollution sources, *Runoff, Fate of pollutants, Parking lots, Water pollution sources, Paving, Water quality, Rainfall-runoff relationships, Ammonium, Metals, Subsurface runoff, Streams, Conductivity, Water temperature, Surburban malls, New York.

Rainfall, surface runoff, and subsurface drainage plus streamflow upstream and downstream of a suburban New York mall parking lot were intensively sampled during and after a thunderstorm on June 18, 1978. Prior to the 11.4 mm which fell within less than 1.5 hours, no rain had fallen for 4 days. Ammonia-N concentrations were high (up to 2.5 mg per liter) in parking lot runoff, a result of precipitation which contained up to 2.0 mg per liter ammonia-N. Surface runoff had a peak in conductivity during the rainfall and returned to prestorm levels by the end of the study period. Initial runoff appeared gray and nearly opaque. Nine constituents (K, Mn, Fe, P, Pb, Zn, Mg, Ca, and Na) showed a peak in surface runoff between 45 and 60 min after the rain started, declined to a low at 75 min, and returned to prestorm values by 105 min. Drainage from subsurface drains was brown in color and had a strong odor. In the receiving stream, water temperature increased and conductivity decreased during the beginning of the storm and returned to prestorm levels after 5 hours. (Cassar-FRC)
W82-04252

OCCURRENCE AND DISTRIBUTION OF CHEMICAL POLLUTANTS IN LAKE MARIUT, EGYPT. II. HEAVY METALS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, A. A. Ezzat, O. A. El-Rayis, and H. Hafez.
Water, Air and Soil Pollution, Vol 16, No 4, p 401-407, 1981. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Heavy metals, *Lakes, Zinc, Copper, Manganese, Iron, Cadmium, *Distribution patterns, Water pollution sources, *Lake Mariut, *Egypt, Industrial wastes, Fish.

This study deals with the occurrence and seasonal distribution of heavy metals in the water and Tilapia fish of Lake Mariut. Six stations were chosen to represent different regions in Lake Mariut. Two additional stations were selected at the connections of Umum Drain and Qala Drain with the lake. The mean concentrations of zinc, copper, iron, manganese, and calcium in the lake water were 10.9, 4.2, 19.1, 26.2, and 0.62 micrograms/liter, respectively. The monthly average values of zinc varied from a minimum of 3.4 micrograms/liter in October 1978 to a maximum of 20.5 micrograms/ liter in May 1979. The metal concentrations in the fish gave higher values for the liver than the stomach concerning zinc, copper, iron, and cadmium. The mean concentrations of zinc, copper, iron, and manganese found in the stomach were markedly higher than those present in the edible flesh of the flank region and the caudal peduncle. (Baker-FRC)
W82-04290

BIOGENIC AND ABIOGENIC POLYNUCLEAR AROMATIC HYDROCARBONS IN SEDIMENTS FROM TWO REMOTE ADIRONDACK LAKES,
Department of Energy, New York. Environmental Measurements Lab.
Y. L. Tan, and M. Heit.
Geochimica et Cosmochimica Acta, Vol 45, No 11, 9 Fig, 7 Tab, 39 Ref.

Descriptors: *Aromatic compounds, *Lakes, *Sediments, Polynuclear aromatic hydrocarbons, Hydrocarbons, *Sagamore Lake, *Woods Lake, *New York, Perylene, Lake sediments, Organic matter, Abietic acid, Retene, Terpenes, Organic compounds, Water pollution sources, Fate of pollutants.

Polynuclear aromatic hydrocarbons (PAH) were determined in sediment cores from Sagamore Lake and Woods Lake, New York, remote from industrial activities. The composition and distribution of the parental PAH in the sediment indicate that the source of PAH in the surface is anthropogenic combustion of fossil fuels. Forest fires were ruled out as a source because sediment cores revealed no trace of the only known fire, which occurred about 80 years ago. All parental PAH, with the exception of perylene, decreased in concentration with depth in the cores. Perylene levels increased dramatically with depth to a maximum at 35 cm and decreased at greater depths. It has been suggested that perylene is transformed from natural precursors in the reducing environment, but the identity of these precursors was not investigated in this study. Concentrations of nonparental PAH were relatively uniform throughout the sediment cores. Some of the products identified were retene and other intermediates in the conversion of abietic acid to retene and hydrochrysenes and hydropicenes derived from pentacyclic triterpenes. Abietic acid is a major component of pine resins, and the pentacyclic triterpenes are widely distributed in higher plants. Concentrations of all parental PAH, except perylene, were higher in Woods than in Sagamore. The sediment densities and sedimentation rates are higher in Sagamore. (Cassar-FRC)
W82-04293

ACIDIC PRECIPITATION: CONSIDERATIONS FOR AN AIR QUALITY STANDARD,
Brookhaven National Lab., Upton, NY.
L. S. Evans, G. R. Hendrey, G. J. Stensland, D. W. Johnson, and A. J. Francis.
Water, Air, and Soil Pollution, Vol 16, No 4, p 469-509, 1981. 3 Fig, 3 Tab, 83 Ref.

Descriptors: *Water quality, *Acid rain, Rainfall, Air pollution, Acidic water, Hydrogen, Fish, Water pollution sources, *Water pollution effects, Ecological effects.

This paper discusses the relationship between precipitation acidity and receptor effects. First, the existence of acidic precipitation is documented, including temporal and spatial variability. A review of receptor characteristics is presented, along with responses to acidic precipitation, describing links between acidic precipitation and enviornmental effects where wuch links are known. Information gaps are highlighted. Finally the possibility of establishing a critical threshold for precipitation acidity is evaluated, which can serve as a meaningful standard to protect to protect terrestrial and/or aquatic biota. The chief anions accounting for the acidity in rainfall are nitrate and sulfate. Greater nutritional benefits are derived from acid rain by agricultural rather than forest systems, when considering soils alone. Acid deposition has caused acidification of fresh waters of southern Scandinavia, southwestern Scotland, southeastern Canada, and northeastern United States. Biological effects of acidification of fresh waters are detectable below a pH of 6.0. As lake and stream pH levels decreased below pH 6.0, many species of plants, invertebrates, and vertebrates were progressively eliminated. Current research inducates that establishing a maximum permissible value for the volume weighted annual hydrogen ion concentration of precipitation at 25 microeq/liter may protect the most sensitive areas from permanent lake acidification. (Baker-FRC)
W82-04302

A PRELIMINARY POLLUTION SURVEY OF THE PAPENKUILS RIVER, PORT ELIZABETH,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and W. D. Emmerson.
Water SA, Vol 7, No 4, p 211-215, October, 1981. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Heavy metals, *Water quality, *Water pollution sources, Path of pollutants, Coliforms, Metals, Sediments, Rivers, *Papenkuils River, Port Elizabeth, *South Africa, Nutrients.

Water samples from 20 sites along the course of the Papenkuils River, Port Elizabeth, South Africa, were analyzed for nutrients (ammonia, nitrite, nitrate, phosphate, and total phosphorus), Escherichia coli, and heavy metals. One identified pollution source was the Fishwater Flats sewage works. Many other unknown industries contributed wastes along the entire length of the river (formerly known as Smelly Creek), causing high metal concentrations in water and sediments and an absence of invertebrate fauns. Fecal coliforms were high near the sewage plant discharge and near a stormwater drain. Highest metal levels in water samples were (in micrograms per liter): Cu, 67, Pb, 326, Zn, 3600, Mn, 650; Ni, 106; Cd, 0.88; Cr, 83; and Hg, 1.047. Highest metal levels in sediments were (in micrograms per g): Cu, 740; Pb, 2400; Zn, 22,400; 465; Co, 6.0; Ni, 96; Cd, 15; Cr, 40,000; and Hg, 2. (Cassar-FRC)
W82-04346

ENGINEERING IN CATFISH PRODUCTION,
For primary bibliographic entry see Field 8I.
W82-04367

COMPARISONS OF SOLUBLE REACTIVE PHOSPHORUS AND ORTHOPHOSPHORUS CONCENTRATIONS AT AN OFFSHORE STATION IN SOUTHERN LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-04377

AREAWIDE STORMWATER POLLUTION ANALYSIS WITH THE MACROSCOPIC PLANNING (ABMAC) MODEL,
RAMLIT Associates, Berkeley, CA.
Y. J. Litwin, J. A. Lager, and W. G. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107947, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-223, October 1981. 3 p, 1 Fig. R-806357.

Descriptors: *Storm runoff, *Computer models, *Storm water, *Water pollution, Simulation, Planning, Land use, Water quality, Rainfall-runoff relationships, Nonpoint pollution sources, Wastewater treatment.

A simplified, continuous, stormwater management model (ABMAC) and user's manual were developed to provide an inexpensive, flexible tool for preliminary assessment of stormwater management strategy over large developed and undeveloped areas. The model, intended for use by local engineers and planners, is adaptable for mini-computer applications. The model is designed to simulate runoff, water quality, storage, and treatment while incorporating time and probability into the analysis. It allows for substantial flexibility in terms of input data requirements and output formats. All simulated quantities vary on a daily basis. The model can simulate nonpoint source pollution from a maximum of six land use categories. Six quality constituents are simulated including one user specified constituent. The application and testing of the model in the San Francisco Bay area, from 1976 to 1978, and 1978 to 1980, indicated satisfactory agreement between recorded and simulated records (within 40%). The model can be used effectively in conjunction with more sophisticated models of stromwater runoff and receiving waters. In such applications, ABMAC looks at broad areas and long periods, whereas the more sophisticated models can be best applied to selected, relatively small watersheds. (Moore-SRC)
W82-04393

SEWAGE SLUDGE PATHOGEN TRANSPORT MODEL PROJECT,
BDM Corp., Albuquerque, NM.
For primary bibliographic entry see Field 5A.
W82-04403

PARASITES IN SOUTHERN SLUDGES AND DISINFECTION BY STANDARD SLUDGE TREATMENT,

Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
R. S. Reimers, M. D. Little, A. J. Englande, D. B. Leftwich, and D. D. Bowman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102344, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-166, October, 1981. 7 p, 2 Fig, 7 Tab. 805107

Descriptors: *Parasites, *Disinfection, *Sludge, *Protozoa, *Wastewater treatment, Heat, Eggs, Helminths, Lime, Ultrasonics, Seasonal variation, Pathogens, Temperature effects.

Sludge samples collected during each of the four seasons from 27 municipal wastewater plants located in Alabama, Florida, Mississippi, Louisiana, and Texas were examined for thee presence and densities of resistant stages of human and animal parasites. Viable eggs of Ascaris and Toxocara were recovered at least once from every plant and viable eggs of Trichuris vulpis and Trichuris trichiura were recovered at least once from 26 and 15 plants, respectively. Viable eggs of at least 10 other helminths and cysts of a few protozoa were also found in fewer numbers and less frequently. Depending upon the parasite, the inactivation of parasites during sewage treatment fluctuated from season to season, but, in general, most were inactivated in the summer. Laboratory studies verified that destruction of resistant parasite eggs is primarily due to temperature (heat) and not to a speciic digestion process. Very large lime doses were required for the inactivation of viable Ascaris in sludges and results were not always consistent. Laboratory experiments also showed that at certain combinations of ultrasonic frequency intensity and exposure time, Toxocara eggs could be destroyed, but that the same ultrasonic conditions did not affect Ascaris eggs. An important finding of this study is the poor suitability of Ascaris eggs taken from the uteri of gravid female worms as indicators of the characteristics of Ascaris eggs discharged in the feces of the host. (Moore-SRC)
W82-04408

DEVELOPMENT OF THE FECAL STREPTOCOCCUS GROUP AND ITS INDIVIDUAL SPECIES AS WATER QUALITY INDICATORS,

Northern Arizona Univ., Flagstaff. Dept. of Microbiology.
H. K. Speidel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211425, Price codes: A02 in paper copy, A01 in microfiche. Report, June, 1981. 13 p. OWRT A-096-ARIZ(1). 14-34-0001-0103.

Descriptors: *Water pollution, *Coliforms, *Bacteria, *Pollutant identification, *Fecal streptococcus, Indicator bacteria, Speciation techniques, Bacterial survival.

Procedures proposed by the U.S. Environmental Protection Agency for the verification and speciation of fecal streptococci were evaluated using 9 standard cultures of streptococci obtained from the American Type Culture Collection (ATCC). The verification portion of the procedure was found to be very useful for the standard cultures as well as environmental isolates. The speciation method was not able to successfully speciate 67% of the standard cultures. The major problems which arose in the use of the speciation scheme included: carbohydrate fermentation reactions, hemolytic reactions, telurite reduction and excessive time and media requirements. A new scheme was developed to speciate the fecal streptococci. Thisnew procedure was based upon differences in the fermentation of six carbohydrates. The new procedure utilizes carbohydrate discs placed on Phenol Red Agar and takes only 24 hours after the verification of the fecal streptococcus isolate. Fecal streptococcal cultures were obtained from a variety of warmblooded animals from the Northern Arizona Region. The cultures were speciated using the new procedure as well as the EPA procedure. The survival of fecal streptococci in an aquatic system was examined by placing the standard cultures into lake water held at 15 C. Samples were taken at 48 hour intervals and viable counts were made. The survival curves obtained classified the organisms into short term, medium term and long term survivors. The data also indicate that the currently used fecal coliform to fecal streptococcus ratio may not be valid especially after 12 hours from the time the organisms enter the water.
W82-04416

RESPONSES OF NORTHERN NEW ENGLAND LAKES TO ATMOSPHERIC INPUTS OF ACIDS AND HEAVY METALS,

Maine Univ. at Orono. Land and Water Resources Center.
S. A. Norton, R. B. Davis, D. F. Brakke, D. W. Hanson, and K. H. Kenlan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211434, Price codes: A06 in paper copy, A01 in microfiche. Report, July, 1981. 90 p, 50 Fig, 6 Tab, 50 Ref, 2 Append. OWRT A-048-ME(1).

Descriptors: *Acid rain, Acidic water, Diatoms, Plankton, *Heavy metals, *Water pollution sources, Cations, Lake sediments, *Lakes, *New England, *Ecological effects.

Ninety-four low-humic lakes in northern New England (82 in Maine) located in largely noncalcareous terrain were studied to detect possible changes in pH and associated effects. Modern colorimetric and electrode pH measurements yield equivalent results plus or minus 0.1 pH unit, permitting comparison of modern electrode pH measurements with older colorimetric measurements. Eight-five percent of the lakes are more acidic now. Studies of present water chemistry indicate that Fe, Mn, Pb, Zn, and Al concentrations tend to be higher with decreasing pH for the set of lakes; Na, K, Ca, Mg, and alkalinity tend to be higher with increasing pH for the set of lakes. Surface sediment chemistry indicates that (at the 95% significance level) the concentrations of Na2O, K2O, MgO, and organics are highest at higher lake pH values; Cu increases with decreasing pH. CaO, FeO, MnO, A12O3, TiO2, Pb, and Zn concentrations do not relate to pH. The relative abundances of taxa of diatom remains in profundal surface sediments from a sub-set of 25 lakes are related to surface water pH's in the range of 4.4 to 7.0. In a cluster analysis, the diatom assemblages from lakes with pH less than 5.7 separate from those with pH greater than 5.8. Greatest taxonomic diversity occurs at pH 5.8. Some unknown factor associated with lake altitude (52 - 1009 m) accounts for scatter in the pH-diatom relationship. In studies of cladoceran associations in profundal surface sediments from 18 of the lakes with a pH range of 4.4 to 6.9, it was not possible to uncouple the effects of pH and altitude (78 - 1123 m). Cladoceran stratigraphy in sediment cores from three high-altitude lakes indicates community changes concurrent with changes in diatom assemblages postulated to be caused by lake acidification.
W82-04420

ESTIMATION OF ACCUMULATION PARAMETERS FOR URBAN RUNOFF QUALITY MODELING,

Geological Survey, Reston, VA.
W. M. Alley, and P. E. Smith.
Water Resources Research, Vol 17, No 6, p 1657-1664, December, 1981. 5 fig, 2 tab, 13 Ref.

Descriptors: *Urban runoff, *Accumulation, *Water quality, *Model studies, Pollutant load, Water pollution sources, Washoff, Fate of pollutants, Runoff, Sensitivity analysis, Paving.

Watershed models use accumulation and washoff equations to simulate the quality of runoff from urban impervious areas. This paper explores methods of estimating accumulation parameters and analyzes the sensitivity of model output to changes in these parameter values. Parameters evaluated are the maximum amount of constituent on effective impervious areas (in kg); the rate constant for constituent removal (per day); and the washoff coefficient (per mm). An equation is given which accounts for observations that the rate of pollutant accumulation is largest for a few days after a rainfall or street cleaning and eventually approaches zero because constituents are resuspended by wind or vehicular traffic. This curve is more general than the linear accumulation curves used in most models. An exponential equation for constituent washoff developed in a previous paper is presented. Results of applying these techniques and sensitivity analysis show that the shape and magnitude of the constituent accumulation curves should be better defined. The amount of residual material remaining on the streets after storms and cleaning must also be considered. (Cassar-FRC)
W82-04432

A FINITE ELEMENT MODEL FOR THE MIGRATION OF LEACHATE FROM A SANITARY LANDFILL IN LONG ISLAND, NEW YORK - PART I: THEORY,

Argonne National Lab., IL.
A. B. Gureghian, D. S. Ward, and R. W. Cleary.
Water Resources Bulletin, Vol 16, No 5, p 900-906, October, 1980. 3 fig, 1 Tab, 31 Ref.

Descriptors: *Leachates, *Model studies, Simulation, Computers, Infiltration, Percolation, Leaching, Soil solution, *Landfills, Sanitary landfills, Waste dumps, Mathematical studies, *Long Island, New York.

This work illustrates the development and accuracy of a two dimensional finite element mathematical model for the migration of ground water contamination. For obtaining a solution to the mass transport equation by means of quadrilateral elements with linear sides, the Upstream (Upwind) FEM seems to be a better choice than the Galerkin FEM to avoid overshoot and oscillations in applying the model to field problems. Due to the fact that the weighting functions are dependent on the cell Courant number, the computational cost will increase slightly if the value of this parameter is other than constant in the progress of the solution. The optimal weighting parameters in the transient simulation need to be precisely defined for grid networks with variable mesh spacing. A field application of the model to the leachate migration from the Babylon sanitary landfill in Long Island, New York, has been carried out. (Baker-FRC)
W82-04434

NUTRIENT AND HEAVY METAL TRANSPORT CAPABILITIES OF SEDIMENT IN THE SOUTHWESTERN UNITED STATES,

New Mexico Univ., Albuquerque. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W82-04437

PROPORTIONS OF SEVERAL ELEMENTS FOUND IN SEWAGE EFFLUENT AND SLUDGE FROM SEVERAL MUNICIPALITIES IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Div. of Animal and Veterinary Sciences.
D. J. Horvath, and R. A. Koshut.
Journal of Environmental Quality, Vol 10, No 4, p 491-497, October/December, 1981. 7 Tab, 30 Ref. A-025-WVA(2).

Descriptors: *Sludge, *Effluents, *Heavy metals, *Wastewater treatment, Metals, Land disposal, Water pollution sources, Cadmium, Zinc, Lead, Nickel, Manganese, Iron, Chromium, Potassium, Magnesium, Phosphorus, Nitrogen, Calcium, Copper, *Municipal wastewater, *West Virginia.

The distribution of 13 elements between sludges and effluents from 11 West Virginia municipal sewage treatment plants was determined from analytical results and the discharge rates. It was obvious that municipalities vary appreciably in their ability to remove elements from wastewater and that the elements vary in behavior. The % of element in effluent followed by % in sludge were Ca, Mg, and K, 82-99, 1-18; Cd, 35-98, 2-65; Cr, 12-86, 9-88; Cu, 15-99, 1-85; Fe, 9-88, 12-91; Mn, 18-81, 19-82; Ni, 30-97, 3-70; Pb, 42-85, 15-58; Zn, 33-84, 16-67; P, 56-96, 4-44; and N, 57-98, 2-43. Ratios of Zn:Cd were 97:1 in influents, 150:1 in sludges, and 30:1 in effluents. Zn:Cu ratios remained about

6:1 through the entire process. This points out cadmium's greater mobility (and the greater environmental threat to water and soil). (Cassar-FRC)
W82-04465

POSSIBLE WATERBORNE TRANSMISSION AND MAINTENANCE OF INFLUENZA VIRUSES IN DOMESTIC DUCKS,
Hong Kong Univ. Dept. of Microbiology.
D. D. Markwell, and K. R. Shortridge.
Applied and Environmental Microbiology, Vol 43, No 1, p 101-116, 1982. 1 Fig, 5 Tab, 25 Ref.

Descriptors: *Water supply, *Diseases, *Contamination, *Ducks, Ponds, Potable water, Public health, *Viruses, Infection, *Influenza, Path of pollutants, Epidemics, Epizootiology, Hong Kong.

The ecology of avian influenza viruses was examined on two duck farms in the Hong Kong area. Monthly examinations were made for a period of 1 year. In one community the predominant virus was H3N2, which is antigenically related to the pandemic Hong Kong strain. The virus was isolated each month from either the feces or the pond water, or both, which suggests a pathway of waterborne transmission. The viruses demonstrated persistence in the community in that 1 and 2 years after the last sampling date viruses of the same antigenic combination were isolated. Infection was asymptomatic. The virus appeared to be dependent on the continual introduction of ducklings susceptible to infection onto virus contaminated water. Ducks 70 to 80 days old were generally free of detectable virus in spite of exposure to virus in pond water. The normal practice of raising ducks of different ages on the same farm and having them share a common water supply seems significant in the large reservoir of influenza viruses in the duck population of southern China. It is conceivable that virus transmission could occur in this manner to other susceptible animals, including humans. (Baker-FRC)
W82-04468

THE FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS,
Henkel KGaA, Dusseldorf (Germany, F.C.). Dept. of Ecology.
For primary bibliographic entry see Field 5D.
W82-04477

OCCURRENCE AND FATE OF CERTAIN TRIPHENYLMETHANE BLUE DYESTUFFS IN THE AQUATIC ENVIRONMENT,
Thames Water Authority, London (England).
M. L. Richardson, and A. Waggott.
Ecotoxicology and Environmental Safety, Vol 5, No 4, p 424-436, 1981. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Dyes, *Degradation, Fate of pollutants, *Pollutant identification, Acid Blue 1, Water analysis, Wastewater analysis, Chlorination, Adsorption, Spectrophotometry, Chromatography.

The presence of the triphenylmethane dye, Acid Blue 1 (Chemical Abstracts Services Registry Number 129-17-9) was determined in the aquatic environment by adsorption of XAD-2 ion exchange resin, elution, and spectrophotometric measurement as well as by high performance liquid chromatography. Concentrations of the dye (in micrograms per liter) were 0.6-1.7 in river and reservoir water, 9.2-12.3 in sewage effluent, and less than 0.4 in finished water. Distilled water and tap water containing 2 to 10 micrograms per liter Acid Blue 1 were chlorinated with water containing 2 to 10 micrograms per liter Acid Blue 1 were chlorinated with 1 mg per liter chlorine for 10, 15 or 30 minutes. Dye was destroyed in all but one case; tap water with a 10 microgram per liter concentration of dye exposed for 10 minutes contained 0.6 micrograms per liter residual dye. Exposure of 4 mg per liter dye in distilled water to 15 hours of continuous simulated sunlight did not measurably reduce the dye concentration. (Cassar-FRC)
W82-04478

ACCUMULATION AND DEPURATION OF METALS BY DUCKWEED (LEMNA PERPUSILLA),
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. R. Clark, J. H. VanHassel, R. B. Nicholson, D. S. Cherry, and J. Cairns, Jr.
Ecotoxicology and Environmental Safety, Vol 5, No 1, p 87-96, 1981. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Heavy metals, *Aquatic plants, *Bioaccumulation, Fate of pollutants, Metals, Cadmium, Copper, Iron, Manganese, Zinc, Chromium, Lead, Nickel, *Duckweed, Macrophytes, Detention reservoirs, Ash, Powerplants.

Duckweed (Lemna perpusilla) accumulated metals (Cd, Cu, Fe, Mn, Zn, Cr, Pb, and Ni) both in a heavy coal ash secondary retaining basin and under controlled laboratory conditions simulating metal concentrations 0.5, 1, 10, 25, and 100 times the levels of metals found in the retaining basin water. Duckweed in the outdoor basin accumulated Cr, Pb, and Ni to a slightly higher extent and Cd, Cu, Fe, Mn, and Zn to a much greater extent than found in sediments. Levels of metals in the basin water were lower than duckweed and sediment concentrations. During a 14-day depuration period concentrations of Pb, Cr, and Ni declined to sediment levels, Cu and Cd levels approached sediment levels, and Zn, Mn, and Fe levels remained considerably higher. During the 10-day laboratory exposures Pb and Cr bioaccumulation was significantly greater than control at levels of 10 times or greater, and Ni accumulation was significant at the 1 x level and above. Duckweed populations showed high mortality at concentrations 10 x and higher. After 8 days depuration the metal concentrations in duckweed were reduced to control levels. Cu and Cd showed high increases in bioconcentration at the 0.5 and 1 x concentrations and were not eliminated during the depuration period. Duckweed accumulated Zn and Mn at the 1 x exposure and above but did not show depuration. Duckweed's capacity to concentrate metals may result in minimal concentrations of these metals in water during the growing season and sudden releases upon natural die-off in the fall, causing unusually high levels of metals at that time. (Cassar-FRC)
W82-04479

A HYDROLOGIC SIMULATION FOR PREDICTING NONPOINT SOURCE POLLUTION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
K. G. Eggert.
PhD Thesis, 1980. 431 p, 41 Fig, 21 Tab, 117 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-10802.

Descriptors: *Hydrologic models, *Water pollution sources, *Watershed management, *Nonpoint pollution sources, Prediction, Mathematical models, Flow channels.

A hydrologic model for use in predicting nonpoint source pollution is developed. The model is a mathematical representation of watershed hydrology and hydraulics. It is formulated to investigate watershed response to management activity. The model simulates water balance on a daily basis by incorporating the processes of evapotranspiration and soil water redistribution resulting from meteorological variations. Surface water runoff is calculated using the kinematic wave approximation for overland and channel flows. The multiple watershed routing component allows large drainage basins to be addressed. Analytic techniques are used for overland flow routing and primary channels, while a numerical solution is used in the main channel segments. Sediment is routed by size fraction using the Meyer-Peter, Muller equation for bedload, and suspended sediment is calculated. Application for validation of individual components is presented. Examples of management alternative impact on water and sediment yields from a hypothetical watershed are also presented. The alternatives examines include clearcut timber harvest by various techniques and the impact of wildland grazing methods. The model's strength are shown to be a flexible computation structure, a minimum of regionally specific code and a representation based on hydrologic and hydraulic processes. The physically based mode allows management alternative changes to be reflected in physically predictable parameters. The model is formulated in such a manner that it may be used to drive other nonpoint source models as required by a specific problem. (Sinha-OEIS)
W82-04485

HYDROLOGIC RECONNAISSANCE OF THE BELUGA, PETERS CREEK, AND HEALY COAL AREAS, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04504

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, TRENTON TO PENNSVILLE, NEW JERSEY, 1980,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04515

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-4A, H-4B, AND H-4C AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
J. W. Mercer, P. Davis, K. F. Dennehy, and C. L. Goetz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153610, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-36, May, 1981. 92 p, 20 Fig, 5 Tab, 5 Ref.

Descriptors: *Radioactive waste disposal, *Geohydrology, *Test wells, *Hydrologic data, Groundwater movement, Transmissivity, Storage coefficient, Testing procedures, Water sampling, Water analysis, *New Mexico, Eddy County, Waste Isolation Pilot Plant.

Data were collected during hydrologic testing at wells H-4A, H-4B, and H-4C in the southern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico. The three water-bearing zones tested, the Magenta and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact, yield water to wells at rates less than 0.9 gallon per minute. Throughout the testing, water-pressure response in the tested zone was monitored by a pressure transducer system. Shut-in and slug tests were conducted to acquire the data from which the following values were derived. Calculated transmissivities for the Magenta, Culebra and the Rustler-Salado contact at wells H-4A, H-4B, and H-4C were 0.06, 0.9, and 0.0006 foot squared per day respectively. Water samples from the Magenta and Culebra had dissolved-solids concentrations of 22,300 and 18,100 milligrams per liter, respectively. The major chemical constituents of ground-water samples from these two zones were sodium, chloride, and sulfate. Water samples from the Rustler-Salado contact had a dissolved-solids concentration of 322,000 milligrams per liter and magnesium, sodium, and chloride were the major constituents. Radium-226, a naturally occurring radioactive element, was present in samples from all three zones. (USGS)
W82-04517

SURVEY OF SELECTED ORGANIC COMPOUNDS IN AQUIFERS OF NEW YORK STATE EXCLUDING LONG ISLAND,
Geological Survey, Albany, NY. Water Resources Div.
R. A. Schroeder, and D. S. Snavely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-139957, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-47, 1981. 60 p, 1 Fig, 8 Tables, 41 Ref.

Descriptors: *Organic compounds, *Groundwater, *Aquifers, *Water pollution sources, Organic wastes, Contamination, Wells, Sampling, Water analysis, *New York.

Samples from 56 wells at 49 sites in New York State, excluding Long Island, were analyzed by gas chromatography/mass spectrometry for the presence of organic compounds designated 'priority pollutants' by the U.S. Environmental Protection Agency. Most samples were taken from public-supply wells tapping shallow, permeable aquifers, the most susceptible to contamination. Analytical sensitivity reported by the laboratory for most compounds was less than 1 microgram per liter, but contamination during collection, shipping, or laboratory processing required that concentrations be about 10 micrograms per liter before the presence of a compound could be confirmed. Only a small percentage of wells sampled in this study was found to be contaminated. Where contamination is present, it probably results from point sources such as landfills or dumps rather than from general sources such as atmospheric deposition or proximity to urban centers. Two sites, Brewster in Putnam County and Olean in Cattaraugus County, showed clear evidence of contamination. Two other sites, Corning in Steuben County and Fulton in Oswego County, showed evidence of possible contamination. (USGS)
W82-04520

A CORRELATION STUDY OF BIODEGRADABILITY DETERMINATIONS WITH VARIOUS CHEMICALS IN VARIOUS TESTS II. ADDITIONAL RESULTS AND CONCLUSIONS,
Henkel KGaA, Dusseldorf (Germany, F.R.).
P. Gerike, and W. K. Fischer.
Ecotoxicology and Environmental Safety, Vol 5, No 1, p 45-55, 1981. 3 Tab, 20 Ref.

Descriptors: *Biodegradation, *Organic compounds, *Toxicity, Activated sludge process, Biological treatment, Wastewater treatment, Degradation, *Fate of pollutants, Water pollution effects.

This paper reports work previously started on biodegradability of 44 compounds by 7 tests (the modification of the OECD Confirmatory Test for the application of the carbon analysis, the Zahn-Wellens, the Japanese MITI, the French AFNOR T 90-302, the Sturm, the Modified OECD Screening, and the Closed Bottle Test according to Fischer). This work added two more tests, the U.S. EPA Activated Sludge Test and a model trickling filter. The following conclusions were based on previous and present work. The AFNOR T 90-302 42-day test is a powerful test for noninhibitory compounds and may exaggerate degradation in some cases, e.g., sulfanilic acid. It is overly sensitive toward inhibitory or toxic materials. The EPA activated sludge test strongly exaggerated the predictive value of biodegradability results for the general environment. Environmentally relevant positive results were obtained from the Closed Bottle Tests, the Modified OECD Screening Test, and the MITI Test. The authors feel that special preacclimation procedures should be excluded in the first step of biodegradability testing and that the test duration be limited to 4 weeks. A group of tests was designated appropriate for fail-safe tests of ready biodegradability with the limits 60% dissolved organic carbon removal or 50% BODT or CO2 production. These were the Japanese MITI test, the French AFNOR T 90-302 Test restricted to 4 weeks, the Sturm Test without the preacclimatization step, the Modified OECD Screening Test extended to 4 weeks, and the Closed Bottle Test according to Fischer. (Cassar-FRC)
W82-04534

ROLE OF NATURAL COLLOIDS IN THE TRANSPORT OF HYDROPHOBIC POLLUTANTS,
Maryland Univ., College Park. Center for Environmental and Estuarine Studies.
J. C. Means, and R. Wijayaratne.
Science, Vol 215, No 4535, p 968-970, February 19, 1982. 2 Fig, 1 Tab, 12 Footnotes.

Descriptors: *Herbicides, *Adsorption, *Colloids, *Fate of pollutants, Atrazine, Linuron, Estuarine environment, Sorption, Organic matter, Salinity, Hydrogen ion concentration, Chesapeake Bay, *Choptank River, *Patuxent River.

Linear Freundlich adsorption coefficients for the herbicides atrazine and linuron were 1850 and 6750, respectively, in a study of waters containing natural estuarine colloids. Water samples collected from the Choptank and Patuxent Rivers near Chesapeake Bay were filtered to enrich the colloidal fraction. Salinities ranged from 1 to 19 o/oo, and carbon contents of the enriched colloidal fractions from 33.5 to 108.5 mg per liter. The herbicide-colloid-water mixtures were equilibrated in a shaker for 18 hours at 20 C. The sorption constants of atrazine decreased from 2200 to 1800 with a salinity increase from 8 to 16 o/oo. Linuron and atrazine showed sorption peaks at pH 8.0. Significant decreases in sorption were observed as pH decreased to 5.0 or increased to 9.0. The high adsorption coefficients suggest that natural colloids may be important in transporting hydrophobic pollutants in the aquatic environment. (Cassar-FRC)
W82-04539

ACID SNOW IN THE CANADIAN HIGH ARCTIC,
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
For primary bibliographic entry see Field 2C.
W82-04542

HEAVY METAL CONTENT IN SEDIMENTS OF LAKES IN SOUTHERN BAVARIA AS A SIGN OF LONG-TERM ENVIRONMENTAL IMPACT (SCHWERMETALLGEHALTE IN SEDIMENTEN SUDBAYERISCHER SEEN ALS INDIKATOREN LANGFRISTIGER UMWELTBELASTUNG),
Munich Univ. (Germany, F.R.). Geographisches Inst.
G. Michler, C. Steinberg, and P. Schramel.
Wasserwirtschaft, Vol 71, No 11, p 323-330, 1981. 4 Fig, 3 Tab, 27 Ref. English Summary.

Descriptors: *Heavy metals, *Lakes, *Sediments, *Bavaria, Germany, Cores, Dating, Limnology, Path of pollutants, History, Isar River, Diversion, Catchment areas, Municipal wastes.

Typical examples of results obtained to date in a study of the heavy metal contents in sediment cores from 18 South Bavarian lakes are presented. The Ammersee core was studied for vertical distribution of heavy metals. The heavy metal contents in the lower layer were taken as the geological background. The heavy metal contents generally increased at an accelerating rate, over time, with some irregularities which could be correlated with historical events and with a decrease in the last 10-20 years corresponding to decreased coal burning. According to the geoaccumulation index, the Ammersee is classified as moderately to heavily loaded with cadmium, heavily loaded with zinc, and scarcely loaded with copper, lead and chromium. The Walchensee illustrates the effects of water use projects on heavy metal levels. Part of the upper Isar and Rissbach flows were diverted into the Walchensee in 1924 and 1949 to provide increased flows for a hydroelectric plant, increasing the catchment area of the Walchensee from 74 sq km to 770 sq km. The metal components could be divided into two groups: those which are deposited at practically constant rates in the absence of increased sedimentation due to water projects, and those whose levels increased continuously even after the construction erosion ended. Copper accumulation is showing a continuous increase accompanying introduction of treated wastewaters into the Isar. The Speichersee is an artificial lake, receiving large volumes of wastewater, from Munich. Even considering its function as a 'heavy metal trap' the concentrations found were alarming. Lead concentrations exceeding 2000 ppm and cadmium concentrations exceeding 100 ppm were found. (Carroll-FRC)
W82-04550

DEVELOPMENT OF IMPROVED STORMWATER QUALITY MODELS,
Union Coll., Schenectady, NY. Dept. of Civil Engineering.
T. K. Jewell, and D. D. Adrian.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No 5, p 957-974, October, 1981. 6 Tab, 16 Ref. OWRT A-095-MASS, B-059-MASS.

Descriptors: *Urban hydrology, *Storm water, *Water quality, Rainfall-runoff relationships, Model studies, Water pollution sources, *Fate of pollutants, Runoff, *Urban runoff.

A method for developing urban storm water pollutant washoff models has been outlined for the purpose of improving reliability of results. The procedure consists of testing several linear and linear transform multiple regression models for estimating pollutant washoff loadings as a function of storm and basin characteristics using measured data. Then the best model can be chosen for each pollutant using the coefficient of determination and othe criteria. Although estimates of buildup and washoff are eliminated, it is still necessary to gather storm event data for each basin to be modeled. The method is illustrated using data from Seattle, Washington, to predict storm event total loadings for long-term simulation purposes. Calculated results were as follows: suspended solids and COD, within the range of reported values; ammonia, slightly less than reported values. (Cassar-FRC)
W82-04559

NEARFIELD PERFORMANCE OF RIVER DIFFUSERS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
A. D. Parr, and J. G. Melville.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 995-1008, October, 1981. 9 Fig, 1 Tab, 10 Ref. OWRT A-077-ALA.

Descriptors: *Diffusers, *Thermal pollution, *Mixing, Rivers, Model studies, Mathematical models, Mississippi River, Powerplants, Heated water, Thermal water, Fate of pollutants, Temperature, Water temperature, Flow characteristics.

A model was developed to describe the flow field induced by a submerged multiport diffuser discharging in a rectangular channel. Nearfield dilution was determined as a function of effluent and ambient flow parameters. A family of curves is given for a range of conditions characteristic of prototype river diffusers (centered and shore-attached). Comparisons of model predictions with data observed in the Mississippi River downstream from the Quad Cities Nuclear Power Station diffuser were generally in agreement. However, the depth-averaged minimum dilution was underpredicted by about 7%, probably as a result of neglecting lateral entrainment. (Cassar-FRC)
W82-04561

ORGANIC CARBON FLOW IN A SWAMP-STREAM ECOSYSTEM,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. J. Mulholland.
Ecological Monographs, Vol 51, No 3, p 307-322, September, 1981. 9 Fig, 6 Tab, 72 Ref. OWRT B-084-NC, B-110-NC.

Descriptors: *Organic carbon, *Litter, *Streams, *Swamps, *Organic loading, *North Carolina, Total organic carbon, Carbon, Decomposing organic matter, Organic matter, Respiration, Detritus, Dissolved solids, Ecosystems, Oxidation, Watersheds, Wetlands, Productivity.

An annual organic carbon budget for a section of Creeping Swamp, North Carolina is presented. Most of the input was allochthonous, with high autochthonous organic carbon input from filamentous algae during February and March. The output of organic carbon by fluvial processes was 36% of total annual inputs, indicating that the swamp section studied was 64% efficient at retaining organic

carbon. Most organic carbon was retained by respiration. Indices of organic matter processing and a loading potential index were used to compare organic carbon dynamics in the Creeping Swamp segment to that of upland stream segments. The organic carbon loading potential of the swamp was greater than that of the comparison streams, due to its great width and complete canopy. The dense vegetation and low gradient of the swamp increase organic carbon retention by maintaining low water velocities with little erosive force, tortuous flow paths and debris dams. Retention and oxidation of organic carbon in the flooded Creeping Swamp ecosystem occurs in the floodplain. A net annual export of organic carbon in the dissolved form is attributed to the extensive drainage network of the swamp stream system. (Geiger-FRC)
W82-04564

SOME EFFECTS OF LAND USE ON BACTERIOLOGICAL WATER QUALITY IN A RECREATIONAL LAKE,
Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, and A. Troth.
Water Research, Vol 16, No 1, p 105-112, January, 1982. 9 Tab, 26 Ref.

Descriptors: *Bacterial analysis, *Land use, *Lake shores, *Water pollution sources, Fate of pollutants, Water quality, Coliforms, Lakes, *Mississippi Lake, *Ontario, Heterotrophic bacteria, Swimming, Eutrophic lakes, Recreation, Chlorophyll a, Diseases, Water pollution effects, Public health.

A bacterial analysis of water samples from Mississippi Lake, a shallow eutrophic lake in Ontario, indicated that the main sources of fecal coliforms were cattle watering sites, farms, public beaches, flooded and substandard septic tanks, and a bird sanctuary. Sampling was done May 28-June 6 and July 20-29, 1976, at 75 shoreline locations, 5 midlake stations and 5 lake bottom locations. Water quality impairment was localized near the suspected pollution sources. After a rain, levels of fecal coliforms and fecal streptococci increased 10-fold in the lake surface water. Bacterial counts returned to previous levels after 2-3 days. Aerobic heterotrophic bacterial counts at mid lake surface sites were 1600 per 100 ml in June and 8270 per ml in July. Average chlorophyll a concentrations were 2.0 micrograms per liter. A survey of cottage residents on the lake indicated that 57 of 67 reported infections were ear infections, which were experienced by3.28% of bathers. Ear infections were more common in the bathers who spent more time in the water. Young people had higher ear infection rates than adults. Suggestions to improve the water quality of this lake are: eliminate cattle watering sites from the lake shore, correct substandard septic tanks, and open more public beaches. (Cassar-FRC)
W82-04567

DETERMINATION OF CHARACTERISTIC VALUES FOR PHYSICAL AND CHEMICAL LAKE SEDIMENT PARAMETERS,
National Swedish Environment Protection Board, Uppsala (Sweden).
For primary bibliographic entry see Field 2H.
W82-04586

THE UNTERWESER AUTOMATIC WATER QUALITY MEASUREMENT SYSTEM,
For primary bibliographic entry see Field 5A.
W82-04588

ATTENUATION OF POLYBROMINATED BIPHENYLS AND HEXACHLOROBENZENE BY EARTH MATERIALS,
Municipal Environmental Research Lab., Cincinnati, OH.
N. M. Lewis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107558, Price codes: A04 in paper copy, A01 in microfiche. EPA-600/S2-81-191, December, 1981. 7 p, 2 Fig, 6 Tab. R-804684-01.

Descriptors: *Polybrominated biphenyls, *Hexachlorobenzene, *Leaching, *Solubility, *Land disposal, Waste disposal, Leachates, Microbial degradation, Pollutants, Adsorption, Soil contamination, Landfills, Water pollution sources.

This laboratory study of the aqueous solubility, adsorption, mobility, and microbial degradation of polybrominated biphenyls (PBB's) and hexachlorobenzene (HCB) was undertaken to provide information on their behavior in the environment, particularly on the potential for their movement through soil at land disposal facilities for hazardous wastes. PBB's were more than 200 times, and HCB more than 2.5 times more soluble in landfill leachate than in distilled water. Also the solubilities of PBB's and HCB were higher in creekwater and landfill leachates than in purified waters; this was correlated with the level of dissolved organics in the waters. HCB showed a greater tendency for adsorption on soils than did PBB's. There was a high direct correlation between the total organic carbon content of the soils and the amount adsorbed. PBB's and HCB were strongly adsorbed by carbonaceous Ambersorb XE-348 from organic solvents. PBB's and HCB remained immobile in earth materials when leached with water and DuPage leachate, but were highly mobile when leached with organic solvents. PBB's and HCB were found to be resistant to microbial degradation. It is recommended that disposal of PBB or HCB wastes dissolved in organic solvents, or co-disposal of PBB or HCB materials with organic solvents be avoided at land disposal sites unless a carbonaceous liner material is used. (Moore-SRC)
W82-04620

TREATMENT EFFECTIVENESS: OIL TANKER BALLAST WATER FACILITY,
Rockwell International, Newbury Park, CA.
For primary bibliographic entry see Field 5D.
W82-04625

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME I, STATE-OF-THE-ART REPORT,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 4C.
W82-04627

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME III, PREDICTIVE PROCEDURE FOR DETERMINING POLLUTION CHARACTERISTICS IN HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
N. P. Kobriger, T. L. Meinholz, M. K. Gupta, and R. W. Agnew.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-124911, Price codes: A10 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/044, February, 1981. 205 p, 25Fig, 36 Tab, 16 Ref, 8 Append. DOT-FH-11-8600.

Descriptors: *Mathematical models, *Computer models, Highways, *Runoff, *Water pollution sources, Storm runoff, *Highway effects, Environmental effects, Urban runoff, Rainfall-runoff relationships.

The purpose of the predictive procedure is to provide highway designers with a simplified tool to estimate the quantity and quality of storm generated highway runoff. The predictive procedure is comprised of a series of equations which can be computerized to form a mathematical model. The procedure is made up of four components correspondng to the following functions: rainfall runoff; pollutant buildup; pollutant wash-off; and constituent loadings. The predictive procedure can be used for Environmental Impact Statements or to determine the loadings for analysis of the pollutant discharge effect of various design storms at a particular site. The procedure can also be used to evaluate existing highway systems. Equations were developed relating runoff volume to rainfall volume for three highway site types: urban elevated bridge decks with 100% paved areas; urban paved and nonpaved drainage areas; and rural flush shouldered highways. Total solids showed the highest correlation with other monitored parameters and is therefore used as the carrier pollutant in the predictive procedure to estimate 16 other parameters. The wash-off coefficients developed for the three highway site types used in this study are: 5.0 for urban elevated bridge decks; 6.5 for urban paved and nonpaved drainage areas; and 12.0 for rural flush shouldered highways. (Moore-SRC)
W82-04629

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME V, HIGHWAY RUNOFF DATA STORAGE PROGRAM AND COMPUTER USER'S MANUAL,
Envirex Inc., Milwaukee, WI.
N. P. Kobriger, and T. M. Krischan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241937, Price codes: A07 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/046, February, 1981. 125 p, 18 Fig, 18 Tab, 2 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Runoff, *Water pollution sources, *Computer programs, Snowmelt, Storm runoff, *Water quality, Hyetographs, Hydrographs, Rainfall-runoff relationships, Path of pollutants.

The Data Storage Program (DSP) was developed as part of a project to determine the characteristics of highway runoff. Due to the nature of the study, an extensive data collection and chemical analysis program was required and more than 14,000 pieces of data were generated. DSP was developed to: retain a large quantity of field generated data in an organized and easily accessible format; permit conversion of standard units to metric; and provide a mechanism by which the data can be recalled for optional plotting or statistical analysis. The data base developed during the project is perhaps the most extensive highway runoff quantity/quality data in existence. This data is available on magnetic tape with access provided by DSP. Highway runoff is highly variable in that it results primarily from precipitation or snowmelts and as such its description contains a rainfall hyetograph, a runoff hydrograph, water quality parameters, dustfall data, and various site characteristics. The program provides a readily available and convenient means for storage and analysis of environmental and operational data collected during future highway runoff studies. (Moore-SRC)
W82-04630

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME IV, CHARACTERISTICS OF HIGHWAY RUNOFF FROM OPERATING HIGHWAYS. RESEARCH REPORT,
Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, D. Gruber, and W. Kreutzberger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241929, Price codes: A08 in paper copy, A01 in microfiche. Federal Highway Administration Report FHWA/RD-81/045, February, 1981. 171 p, 43 Fig, 41 Tab, 27 Ref, 2 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Runoff, *Water pollution sources, *Storm runoff, *Highway effects, Environmental effects, Rainfall-runoff relationships, Nutrients, Heavy metals, Particulate matter, Oxygen demand, Coliforms, Oil pollution, Fate of pollutants.

From the Spring of 1976 to September 1977, a total of 159 storm events were monitored at six sites: three sites in Milwaukee, Wisconsin; one in Harrisburg, Pennsylvania; one in Nashville, Tennessee; and one in Denver, Colorado. The data were evaluated for: rainfall/runoff relationships; highway runoff pollutant loadings and variations with time; differences in pollutant characteristics from paved and non-paved areas; and correlation of pollutants among measured parameters as well as with highway operation related factors. The average runoff volume to rainfall volume coefficients for non-winter storm events were found to vary between 0.20 to 0.92. Most heavy metals were associated with the particulate matter in highway runoff. The average BOD5 values in highway runoff were found to be comparable with effluent from a well

operated secondary municipal treatment plant. The nutrient loadings were generally comparable to urban stormwater runoff. Sizable concentrations of total coliforms, fecal coliforms, and fecal streptococci were found at all sites. The average oil and grease concentrations in monitored storm events ranged between 1 mg/l at the all-grassy site to 20 mg/l at the all-paved site. Generally, the all-paved site showed the highest loadings for various constituents. (Moore-SRC)
W82-04637

SYNTHESIS AND DEGRADATION OF CARBOHYDRATES IN THE MARINE PLANKTONIC COMMUNITY OF EUTROPHIC WATERS (SYNTHESE ET DEGRADATION DES COMPOSES GLUCIDIQUES AU SEIN DE LA COMMAUNAUTE PLANCTONIQUE EN ZONE MARINE EUTROPHE),
Arago Lab., Banyuls-sur-Mer (France).
G. Cahet, P. Crassous, J. Neveux, and F. Rassoulzadegan.
Internale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 223-248, 1981. 12 Fig, 4 Tab, 38 Ref. English summary.

Descriptors: *Plankton, *Eutrophication, *Marine bacteria, Marine algal, Nutrients, Euphotic zone, Dissolved organic matter, Metabolism, *Carbohydrates, Phytoplankton.

Relationships between heterotrophic activity and phytoplankton excretion were studied in naturally and artificially eutrophicated systems. Excretion appears to have a greater significance in zones of low phytoplankton content than of high content. It increases in the presence of light and ammonium ion. Ion exchange resin analysis of the excreta indicated that the acid fraction generally dominates, while the neutral (glycid) fraction is more significant under dim light conditions. Two enrichment studies on eutrophic and oligotrophic marine waters. In the first case heterotrophy increases with algal biomass; in the second case a first heterotrophic optimum precedes the exponential growth phase of the algae and a second optimum follows. The findings aid in explaining the observed variations in degradation of organic matter depending on the phytoplankton composition. The metabolic adaptability of the bacterioplankton appears responsible for their ability to thrive in nutrient-poor water. In upwelling zones the bacterioplankton activity determines the chemical composition of the water. It also contributes to the maintenance of low dissolved organic carbon contents across large gradients of primary productivity in the photic zone. (Carroll-FRC)
W82-04672

DISPERSION COEFFICIENTS IN ESTUARIES,
Birmingham Univ. (England).
J. R. West, and T. W. Broyd.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 721-737, September, 1981. 7 Fig, 3 Tab, 27 Ref.

Descriptors: *Saline water intrusion, *Solute transport, *Mixing, *Dispersion coefficients, Tidal hydraulics, Fate of pollutants, *Estuaries, Tidal effects.

Published methods of predicting longitudinal dispersion coefficients for estuaries were compared using field data from five British estuaries, Mersey, Conwy, Tay, Usk, and Thames. Values of dispersion coefficients predicted by theoretically based expressions gave values within a factor of three of the gross field data values for mean tidal range and low river flow in all five estuaries. In the narrow, shallow estuaries the transverse oscillating shear mechanisms were dominant. Transverse gravitational shear mechanisms dominated in the wide estuaries. An empirical expression predicted tidal mixing within a factor of five of the field data values. The theoretical and empirical expressions can provide useful estimates of dispersion coefficients if carefully used. (Cassar-FRC)
W82-04684

PRESCRIBED FIRE: EFFECTS ON WATER QUALITY AND FOREST NUTRIENT CYCLE,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 4C.
W82-04690

SELECTED TRACE METALS IN THE UPPER ST. JOHNS RIVER AND THEIR LAND USE RELATIONSHIPS,
General Battery Corp., Reading, PA.
J. A. Leed, and T. V. Belanger.
Florida Scientist, Vol 44, No 3, p 136-150, 1981. 8 Fig, 5 Tab, 14 Ref.

Descriptors: *Rivers, *Trace metals, *St Johns River, Florida, Land use, Path of pollutants, Water pollution sources, Copper, Zinc, Iron, Environmental effects, Water analysis, Fish, Sediments.

In this study iron, copper and zinc were monitored in four species of fish, in the water and in sediments of the upper St. Johns River in order to evaluate land use-water quality relationships. The role of natural interacting processes was also investigated in regulating surface water trace metal concentrations, the accumulation of trace metals in bottom sediments and fish tissues, the relationships between fish weight or total length and trace metal levels in the muscle, gills, and liver, and the relationship between volatile solids (organic matter) and trace metal concentrations in the sediments. Total copper and zinc were present at low concentrations in the surface waters of the upper St. Johns River, but total iron frequently occurred at concentrations exceeding the state standard of 300 micrograms/liter. Levels of total iron appear to be regulated by resuspension of bottom sediments caused by increased discharge and resulting turbulence. Groundwater inputs may influence trace metal content, particularly of iron. The average surface water total iron was highest in the headwaters region of the river above Lake Helen Blazes, decreasing in a northward direction to Lake Washington, and increasing to Lake Poinsett. Higher levels of iron, copper and zinc were found in sediments containing higher percentages of organic matter. Analysis of these metals in the tissues of fish indicates that they are concentrated in the liver, with lower amounts in the gill and muscle tissue. Total copper and total zinc were highly correlated to land use associated with urban activities. (Baker-FRC)
W82-04718

INFLUENCE OF AN AMERICIUM SOLID PHASE ON AMERICIUM CONCENTRATIONS IN SOLUTIONS,
Battelle Pacific Northwest Labs., Richland, WA.
D. Rai, R. G. Strickert, D. A. Moore, and R. J. Serne.
Geochimica et Cosmochimica Acta, Vol 45, No 11, p 2257-2265, November, 1981. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Americium, *Solubility, *Radioactive waste disposal, Waste disposal, Fate of pollutants, Equilibrium, Hydrogen ion concentration, Minerals, Sorption, Chemical precipitation, Solute transport, *Groundwater pollution.

Solubility mechanisms of americium, a long-lived waste product of nuclear energy production, were studied to predict Am concentrations in groundwaters. Suspensions of sediments contaminated with acidic (pH 2.5) liquid radioactive wastes were equilibrated in 0.0015 M CaCl2 solutions adjusted with NaOH to pH of 4.35, 5.3, 6.8, and 7.72 for 100 days. The solubility-limited Am concentrations decreased 10-fold with one unit increase in pH. An equation is presented for predicting Am concentrations in solutions containing contaminated sediments from old waste disposal sites. It is not applicable to high carbonate groundwaters. Lithospheric materials such as granite, basalt, tuff, and salt generally contain alkaline groundwater, and therefore Am is not expected to be very mobile in this environment. The chemical form of Am in aqueous solution is probably $Am(OH)2+$; the form in soil was not determined, but is probably not $Am(OH)3$. Published data on sorption coefficients of Am by different rocks, soils, and minerals were evaluated. Final Am solution concentrations calculated from sorption coefficients of earth materials with solutions agreed well with concentrations predicted from the solubility of solid Am in soil. This indicates that sorption coefficient data are controlled by Am precipitation. (Cassar-FRC)
W82-04720

GROUND WATER MONITORING OF UNDERGROUND COAL MINES,
Moody and Associates Inc., Meadville, PA.
B. A. Waite.
Mining Engineering, Vol 34, No 2, p 170-171, February, 1982.

Descriptors: *Monitoring, *Groundwater movement, *Coal mining, Mining engineering, *Regulations, Dewatering, Drainage effects, Observation wells, Wells.

The coal mining industry has been concerned about the new regulations requiring groundwater monitoring of underground mines. A study of 30 monitoring plans for existing mines in Pennsylvania, West Virginia, and Ohio indicates that for deep mines ranging from 20-81 sq km, 5 to 20 monitoring wells will be required. Variables to consider in electing monitoring locations are aerial coverage of the mine, topographic and structural settings, position of the aquifer in relation to coal seams, population densities, and mining status of various sections of the mine. Possible problems caused by installing monitoring wells include caveins, undesirable dewatering, and disruption of mining plans. Methods for minimizing adverse effects on groundwater are sealing mining openings on completion of mining, providing additional roof supports in wet areas, and avoiding excessively fractured zones. Mine operators face difficulties in collecting data and in being responsible for groundwater supply and quality. For example, considerable money and time may be expended trying to substantiate or refute lost water claims. Future development in a dewatered area may force the coal company to provide a water supply for home owners and industry. It may be difficult or impossible to obtain permission to enter private property and adjacent coal mines to obtain data as required for regulatory compliance. (Cassar-FRC)
W82-04750

5C. Effects Of Pollution

METABOLIC RESPONSES OF AQUATIC BACTERIAL POPULATIONS TO SELECTED INSECTICIDES,
Texas Univ. Health Science Center at Houston. School of Public Health.
H. E. Murray, and R. K. Guthrie.
Water Resources Bulletin, Vol 16, No 4, p 749-751, August, 1980. 3 Fig, 9 Ref.

Descriptors: *Bacteria, *Insecticides, *Oxygen uptake, Water pollution effects, Biodegradation, Metabolism, Malathion, Sevin, 1-Naphthol, Aquatic bacteria, Warburg respirometry, Lake Houston samples, Laboratory tests, Aquariums.

Bacterial populations from Lake Houston were exposed in laboratory aquariums to 5 mg per liter concentrations of sevin or malathion at temperatures of 23, 28, and 33 C. Predominant genera were Pseudomonas, Alcaligenes, Flavobacterium, Bacillus, and Enterobacter. Increased uptake of oxygen as measured by Warburg manometry indicated degradation of sevin by the bacteria. Addition of 1-naphthol, the principal degradation product of sevin, produced the same stimulation of bacterial growth. Plate counts were higher for 3-5 days following sevin or 1-naphthol addition and returned to normal after 10-14 days. Addition of malathion or malathion monocarboxylic acid did not affect metabolic rates at any temperature. However, at 33 C a slight inhibition in bacterial growth was noted. Bacterial counts rose when malathion was reapplied to the aquariums after 2 weeks, possibly indicating a selection of genera able to metabolize the chemical. (Cassar-FRC)
W82-04257

EFFECTS OF PHENOL ON OXYGEN CONSUMPTION IN THE WHELK, BULLIA DIGITALIS (DILLWYN),
Cape Town Univ., Rondebosch (South Africa). Dept. of Zoology.
T. Golombick, and A. C. Brown.
South African Journal of Science, Vol 76, No 8, p 375, August, 1980. 16 Ref.

Descriptors: *Phenols, *Shellfish, *Toxicity, Oxygen demand, *Sea water, Control waters, Effluents, Industrial wastes, *South Africa, Water pollution effect.

High concentrations of pheolic compounds were found from an industrial effluent discharging into the sea on the west coast of south Africa near Cape Twon. To assess potential effect of the discharge, oxygen consumption in large female whelks (Bullia digitalis) was measured after exposure to phenol in natural sea water at 15 deg C. Animals exposed to 0.1% phenol for five minutes died after returning to sea water. Those exposed to 0.005% phenol all recovered although stress symptoms were noted. At 0.1% phenol, oxygen uptake showed an immediate sharp decrease and fell to about 1/5 the control level. At 0.005% phenol, oxygen uptake increased to double the control value. thus, high concentrations caused a decrease and low concentrations caused an increase. These results are consistent with results found by other researchers with other invertebrates. (Small-FRC)
W82-04262

APPLICATION OF THE OECD EUTROPHICATION MODELING APPROACH TO LAKE RAY HUBBARD, TEXAS,
Brown and Caldwell, Sacramento, CA.
E. M. Archibald, and G. F. Lee.
Journal of the American Water Works Association, Vol 73, No 11, p 590-599, November, 1981. 13 Fig, 2 Tab, 14 Ref.

Descriptors: *Lakes, *Eutrophication, *Phosphorus, *Lake Ray Hubbard, *Texas, Dallas, Water quality, Reservoirs, Water pollution effects, Dissolved oxygen, Oxygen, Taste, Odor, Model studies, Algae, Nutrients, Chlorophyll a, *Water pollution control.

Lake Ray Hubbard, Texas, used for drinking water and recreation by the Dallas Water Utilities, was the site of algal-related taste and odor problems during the mid-1970's. The lake, of area 550 million cu m and average depth 6.3 m, is divided into four areas, the Main Body and three arms. Extensive water quality sampling and application of the Organization for Economic Cooperation and Development eutrophication models showed that low flows from the Lake Lavon arm into the Main Body increased the average chlorophyll a levels from 6.5 to 11.5 micrograms per liter for 1976-77 data. The models predicted that an 85% reduction in phosphorus in domestic wastewater discharged into the lake would significantly improve water quality. However, it is unlikely that the P load can be sufficiently reduced to maintain oxygen in the hypolimnion during the thermal stratification period unless period unless both point and nonpoint pollution sources are strickly controlled. Increased population in the watershed will aggravate the problems of disagreeable tastes and odors, shortened filter runs, and trihalomethane formation. (Cassar-FRC)
W82-04278

DIEL VARIATION IN THE ABUNDANCE, VERTICAL DISTRIBUTION, AND SPECIES COMPOSITION OF PHYTOPLANKTON IN A EUTROPHIC ENGLISH LAKE,
Freshwater Biological Association, Ambleside (England).
E. Frempong.
Journal of Ecology, Vol 69, No 3, p 919-939, 1981. 7 Fig, 2 Tab, 58 Ref.

Descriptors: *Eutrophication, *Phytoplankton, *Lakes, *England, Vertical distribution, Seasonal variation, Stratification, Thermal stratification.

The diel distribution of chlorophyll and component species throughout the water column in a productive English lake over a range of seasonal phases is discussed. Esthwaite Water is the lake, with an area of about 1 square kilometer, a mean depth of 6.4 meters, and a maximum depth of about 15.5 meters. The lake is composed of three basins. About 83% of the total lake volume is within the 8 meter depth isobath. Eight sampling periods were arranged between June 1977 and September 1978. The seasonal variation of environmental factors, such as thermal and density stratification, largely controlled the size of the diel variations in biomass concentrations. Under strongly stratified conditions and with little turbulence the amplitude of the diel variations increased, and the influence of many factors was restricted to the upper water layers. High daytime light flux influenced the distribution of the dominant motile algae. Sub-surface population maxima under high surface light flux were also noted for two buoyant species, Anabaena flos-aquae and A. solitaria. Loss or accumulation of phytoplankton at the sampling site by lateral transport was associated with wind-induced water movements. Two flagellates, Ceratium hirundinella and Cryptomonas ovata, showed diel vertical migration. Pseudo-diel variations were recognized and linked to weather events with some degree of regularity. (Baker-FRC)
W82-04294

ACIDIC PRECIPITATION: CONSIDERATIONS FOR AN AIR QUALITY STANDARD,
Brookhaven National Lab., Upton, NY.
For primary bibliographic entry see Field 5B.
W82-04302

RESPONSES OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. II. PURE CULTURE VS. MIXED CULTURE RESPONSE,
Texas Univ. at Austin. School of Public Health.
R. K. Guthrie, U. A. Anugwelem, and E. M. Davis.
Water Resources Bulletin, Vol 17, No 6, p 1005-1007, December, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Bacterial analysis, *Indicators, *Carbaryl, *Pollutant identification, Pathogens, Bioindicators, Microbiological studies, Insecticides, Coliforms, Escherichia coli, Streptococcus faecalis, Salmonella typhimurium, Staphylococcus aureus, Water pollution effects.

The effects of 1 or 5 mg per liter carbaryl in water on bacteria were studied on pure and mixed cultures. Bacteria were the indicators, Escherichia coli, and Streptococcus faecalis, and the pathogens, Salmonella typhimurium and Staphylococcus aureus. Oxygen uptake was inhibited by 5 mg per liter carbaryl in all pure cultures. E. coli and . typhimurium pure cultures showed increased oxygen uptake in 1 mg per liter carbaryl. Mixtures of all 4 bacteria showed no increase in oxygen uptake. Carbaryl at 1 and 5 mg per liter significantly inhibited oxygen uptake for mixtures of E. coli-S. faecalis and E. coli-S. aureus, significantly increased oxygen uptake for E. coli-S. typhimurium, and insignificantly increased oxygen uptake for S. typhimurium-S. aureus. Carbaryl had no effect on S. typhimurium-S. faecalis mixtures. Survival times in 5 mg per liter carbaryl were > 8 days for pure and mixed cultures of E. coli, pure cultures of S. faecalis, and mixed cultures of S. typhimurium; < 8 days for pure and mixed cultures of S. aureus, mixed cultures of S. faecalis, and pure S. typhimurium. In mixed cultures in the presence of carbaryl the one pathogen (S. typhimurium) had increased survival time and one indicator (S. faecalis) had reduced survival time. This would make S. faecalis unsuitable as an indicator of fecal pollution under these conditions. (Cassar-FRC)
W82-04341

RESPONSE OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. I. RESPONSE OF BACTERIAL INDICATORS VS. RESPONSE OF PATHOGENIC BACTERIAL SPECIES,
Ife Univ. (Nigeria). Dept. of Environmental Health.
U. A. Anugwelem, R. K. Guthrie, and E. M. Davis.
Water Resources Bulletin, Vol 17, No 6, p 1000-1004, December, 1981. 3 Fig, 9 Ref.

Descriptors: *Bacterial analysis, *Indicators, *Carbaryl, *Pollutant identification, Pathogens, Bioindicators, Microbiological studies, Insecticides, Coliforms, Escherichia coli, Streptococcus faecalis, Salmonella typhimurium, Staphylococcus aureus, Water pollution effects.

The effects of 1 or 5 mg per liter carbaryl in water on fecal pollution indicators (Escherichia coli and Streptococcus faecalis) and the pathogens (Salmonella typhimurium and Staphylococcus aureus) were determined by plate counts and Warburg respirometry. Growth of gram negative lateria, E. coli and S. typhimurium, were initially stimulated by carbaryl, whereas gram positive bacteria, S. faecalis and S. aureus, were inhibited. Over the 8 day study all bacteria died off more rapidly in the presence of carbaryl. Small concentrations of carbaryl can lead to incorrect conclusions in bacterial analysis of water. In some cases indicators died off before pathogens, contrary to the requirements for an indicator bacteria. The ratio of fecal coli to fecal streptococci would lead to false impressions during the period of initial growth stimulation. (Cassar-FRC)
W82-04342

WHEN A WATER SUPPLY WENT BAD.
American City and County, Vol 96, No 12, p 33, 35-36, December, 1981.

Descriptors: *Municipal water, *Chemical wastes, *Activated carbon, *Water pollution effects, *Water treatment, Adsorption, Trichloroethylene, Water supply, Rockaway, *New Jersey, Organic compounds, Political aspects.

Two New Jersey communities, Rockaway Borough and Rockaway Township, handled toxic organic chemical pollution of their water supplies by installing activated carbon water treatment systems. Testing of municipal well water showed trichloroethylene levels as high as 554 ppb in borough water and 180 ppb in township water. The township water was also contaminated with diisopropyl ether and methylene chloride, gasoline additives leaking from a gas station storage tank. Potable water was supplied to residents from water trucks until the activated carbon treatment systems were placed in operation, 21 days for the township and about 6 weeks for the borough. Although sources of chemicals were identified and corrective measures taken, high levels of organic chemicals remained in the well water. However, the carbon adsorption systems removed the contaminants to below the 1 ppb detection limit. (Cassar-FRC)
W82-04357

IRRIGATION, CROP YIELD AND DRAINAGE AT THE VAALHARTS IRRIGATION SCHEME: 3. THE INFLUENCE OF SALINIZATION ABOVE A SHALLOW GROUND WATER TABLE ON THE YIELD OF WHEAT AND OTHER CROPS (IN AFRIKAANS),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
For primary bibliographic entry see Field 2G.
W82-04359

COMBINED EFFECTS OF CADMIUM AND ZINC ON A LAKE MICHIGAN ZOOPLANKTON COMMUNITY,
Argonne National Lab., IL.
J. S. Marshall, D. L. Mellinger, and J. I. Parker.
Journal of Great Lakes Research, Vol 7, No 3, p 215-223, 1981. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Cadmium, *Zinc, *Toxicity, *Zoopankton, Metals, Heavy metals, Crustaceans, Lakes, *Lake Michigan, *Green Bay, *Water pollution effects, Population density, Dissolved oxygen, Species diversity, Species composition.

The effects of cadmium and zinc alone and in combination on the zooplankton community of Green Bay, Lake Michigan, were studied in situ during duplicate 3-week experiments conducted in

8 liter plastic carboys suspended in the epilimnion. Metal treatments (all in micrograms per liter) were: (1) Cd, 2; (2) Zn, 100; (3) Cd, 2, plus Zn, 100, and (4) Cd, 1 plus Zn, 50. Cd109 and Zn 65 were used as tracers to determine the sorption of Cd, and Zn by the different particle size fractions. All four treatments significantly reduced total crustacean density, species diversity, community similarity indexes, and final dissolved oxygen concentrations during the August 1-22, 1978, run. Average crustacean densities for the treatments were: control, 68 plus or minus 11.9, (1) 46.1 plus or minus 15.4, (2) 21.9 plus or minus 6.0, (3) 17.3 plus or minus 1.4, and (4) 30.8 plus or minus 6.4. The effects of treatment (3) were similar to those of 100 micrograms Zn per liter alone since Cd uptake by zooplankton was reduced by the Zn. Results suggest that less than a ten-fold increase in Zn levels in the lake (from the present 5 micrograms per liter) would have pronounced effects on the plankton community. (Cassar-FRC)
W82-04379

ULTRAPLANKTON BIOMASS, PRODUCTIVITY AND EFFICIENCY IN LAC MATAMEC, A PRECAMBRIAN SHIELD LAKE,
Waterloo Univ., (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-04383

THE EFFECTS OF SEDIMENTATION ON AQUATIC LIFE OF THE KANKAKEE RIVER, PHASE II: QUANTITATIVE STUDIES AND THREATENED, ENDANGERED, AND RARE SPECIES,
Illinois Natural History Survey, Chicago.
A. R. Brigham, L. B. Suloway, and L. M. Page.
Document No. 81/37 November 1981. Illinois Department of Energy and Natural Resources, Chicago. 16 p, 5 Fig, 8 Tab, 24 Ref.

Descriptors: *Sedimentation, *Substrates, Sediments, Sand, Silt, *River flow, Biological samples, Biomass, Benthic flora, Benthic fauna, Macroinvertebrates, Rivers, Mussels, Fish, Fish populations, *Ecological effects, *Aquatic life, *Kankakee River, Illinois.

Increased sediment transport is considered the most serious water pollution problem in Illinois. Of concern is that when sediments washed into the Kankakee in Indian reach the slower-moving Illinois portion of the river, diversity and abundance of aquatic life are reduced. The objectives of this study were to assess the impact in Illinois of upstream activities that might increase sediment transport, especially upstream of Kankakee, by quantitatively estimating principal macroinvertebrate populations associated with known substrate types, and to combine this sampling with other sampling to assess the status of endangered or threatened species. In 1979, 44 species of fish were collected. Sites where sand or silt-sand substrates predominated supported fewer species, fewer individuals, and lower biomass than sites with coarser substrates. The transition area had about the same number of species and biomass but fewer individuals as sites where coarser substrates predominated. Thireeen species of mussels were collected. Predominantly sand substrates support few, if any, mussels. Density and number of species were varied at sites with substrates other than predominantly sand. Sedimentation of the non-sand areas would destroy part of the mussel fauna. Also in 1979, 143 taxa of benthic macroinvertebrates were collected. Sites with progressively more complex substrates supported more taxa. Sites where sand or sand-silt substrates predominated supported fewer taxa than sites with substrates composed of silt, sand, gravel, cobble and/or bedrock. (Atkins-Omniplan)
W82-04389

A STRESS FUNCTION FOR EVALUATING STRATEGIES FOR WATER QUALITY MANAGEMENT,
Illinois Natural History Survey, Urbana.
W. U. Brigham, and D. L. Hey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109828, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-217, October, 1981. 4 p, 1 Tab. R-805614-01-0

Descriptors: *Water quality management, *Computer models, *Toxicity, *Water pollution effects, *Bluegills, *Stress, Carp, Aquatic environment, Ammonia, Seasonal variation, Combined sewer overflows, Oxygen demand, Effluents, Residual chlorine, Fish.

This investigation explores the relationship between biological communities and the physical and chemical conditions in the aquatic environment. Seasonal patterns and the duration and probability of the occurrence of chemical conditions and physicial events are established by means of computer modelling. An instantaneous measure of stress is calculated by summing the decimal fractions of the 96-hr lethal concentrations (for bluegills) of each of 21 toxicants. These data are summarized as a quasicontinuous stress function calculated over 1-hr intervals. The stress function is related to five distinct biological communities ranging from the most to the least tolerant of pollution. Data from a test watershed in northeastern Illinois yielded stress functions as follows: 0.120 to 783.7 (mean 23.02) from a site with no fish, 0.155 to 98.47 (mean 1.038) from a site with a carp population, and 0.005 to 0.279 (mean 0.116) from a site with a bass population. A hypothetical management plan to reduce the ammonia component at the no-fish site was incorporated into the stress function. This plan limited effluent ammonia concentrations to 1.5 mg/liter during summer months and 4.0 mg/liter during the winter, eliminated combined sewer overflows, reduced sediment oxygen demand levels substantially, and increased dissolved oxygen levels moderately in treatment plant effluents. Mean stress was reduced from 23.02 to 2.12- more than an order of magnitude. This level was still significantly higher than that of the carp site, primarily because of residual chlorine in the effluents from wastewater treatment plants. These results suggest that if species other than carp are desired in the fishery, further control strategies might need to be implemented. (Author's abstract)
W82-04407

RELATIVE EFFECTS ON STREAM BIOTA OF CHLORINE AND AMMONIA OCCURRING IN SECONDARY SEWAGE,
Southern Illinois Univ. at Carbondale.
W. M. Lewis, R. C. Heidinger, M. H. Paller, and L. J. Wawronowicz.
Document No 81/35, November, 1981. Illinois Department of Energy and Natural Resources. 253 p, 19 Fig, 12 Ref, 14 Append.

Descriptors: *Chlorine, *Ammonia, *Residual chlorine, *Effluents, *Secondary wastewater treatment, Fish toxins, Dissolved oxygen, Turbidity, Fish populations, Algal control, Invertebrates, Stream biota, Water pollution, Streamflow, Toxicity, Pollutants, *Illinois, Water quality standards.

According to Illinois pollution standards, sewage treatment plants cannot legally dischange an effluent which elevates stream total ammonia levels above 1.5 mg/l. Prior studies suggest that chlorine added to secondary sewage effluent as a disinfectant is the principal environmental toxicant, not ammonia, as was previously thought. This study examined the relative effects of the two pollutants. Three streams receiving chlorinated secondary sewage were monitored for significant biotic and abiotic variables. After a year, chlorination was stopped to observe any changes that might occur when only ammonia was present. It was found that eliminating residual chlorine from god quality secondary sewage effluents will result in quantitative and qualitative restoration of fish communities. Further conclusions were that eliminating residual chlorine from poor quality sewage effluents will not necessarily revive fish communities; that high ammonia-nitrogen concentrations did not affect the distribution of fishes in these three streams (but might in high quality streams with much pollution-sensitive taxa); that effluent turbidity can limit fish distribution; that cessation of chlorination did not result in excessive algal growth and significant decreases in dissolved oxygen if effluent quality is good and flow rates are moderately high; that invertebrate communities may show favorable quantitative but not qualitative responses to chlorination cessation in good quality secondary sewage effluent; and that the effects of highly toxic sewage may be more severe in winter than in summer. In most cases, cessation of chlorination will be environmentally more beneficial than tertiary ammonia removal. (Atkins-Omniplant)
W82-04409

THE ECOLOGICAL SIGNIFICANCE OF A STUNTED WHITE PERCH POPULATION IN AN EUTROPHIC MAINE POND,
Maine Univ. at Orono. Land and Water Resources Center.
R. Hines.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211517, Price codes: A04 in paper copy, A01 in microfiche. MS Thesis, May, 1981. 45 p, 8 Fig, 10 Tab, 61 Ref, 1 Append. OWRT B-018-ME(1).

Descriptors: Fish food organisms, Fish management, *Fish populations, *Eutrophic lakes, Food chains, *Perch, Trophic level, *Growth rates, White perch, Hermon Pond, *Maine, Ecological effects.

A study was conducted to evaluate the ecological role of an abundant white perch (Morone americana Gmelin) population in an eutrophic pond, Hermon Pond, Maine. Data on growth and feeding habits for this population were combined with published literature to construct food web models for the pond community. The responses of these model systms to the manipulation of fish stocks were predicted using loop analysis with special attention being paid to those changes that would affect fishing and water quality. The diet composition of yearling-plus white perch varied markedly with season and size. In August and September, 1979, and in July, 1980, perch less than 220 mm fed largely on the aquatic larvae and pupae of Diptera. In May, 1980, the diet was a mixture of immature insects and cladocerans. By June, these perch were feeding mainly on daphnids. White perch larger than 220 mm were largely piscivorous. Growth and age determinations indicated that the white perch population was characteristically stunted. The growth rate of white perch in the study population was slow when compared with growth rates reported for populations in other waters; however overabundant and stunted populations are common in many other areas. Several studies indicate that predation pressure may counteract the species' tendency to overpopulate and stunt. Loop analysis of the seasonal food web models suggests that management efforts for white perch should be directed at reducing the number of young-of-the-year. The introduction of an openwater piscivore may be a way to implement this strategy in eutrophic Maine waters.
W82-04418

RESPONSES OF NORTHERN NEW ENGLAND LAKES TO ATMOSPHERIC INPUTS OF ACIDS AND HEAVY METALS,
Maine Univ. at Orono. Land and Water Resources Center.
For primary bibliographic entry see Field 5B.
W82-04420

HEALTH EFFECTS OF ALTERNATE DISINFECTANTS AND THEIR REACTION PRODUCTS,
Environmental Protection Agency, Cincinnati, OH.
R. J. Bull.
Journal of the American Water Works Association, Vol 72, No 5, p 299-303, May, 1980. 10 Tab, 19 Ref.

Descriptors: *Disinfection, *Water treatment, *Chlorinated hydrocarbons, *Toxicity, Water pollution effects, Chlorination, Chlorine dioxide, Ozone, Chlorine, Chloramine, Drinking water, Organic compounds, Carcinogens, Public health, Chlorites, Trihalomethanes, Reviews.

The health effects of the water disinfectants, chlorine dioxide, chloramines, and ozone, are reviewed. Many studies concentrated on chlorine dioxide and its inorganic byproducts, chlorite and chlorate. Chlorite produces methemoglobinemia in humans and laboratory animals. Unlike nitrite, chlorite is hemolytic. Similar changes are produced by chlorate, but the observed changes disappear with continued exposure after 2 months. No significant effects of 5 mg per liter chlorite in drinking water were observed in the population of a small town. However, red cell glutathione and 2,3-diphosphoglyceric acid were not determined. One individual with glucose-6-phosphate dehydrogenase deficiency showed 15% decreases in hemoglobin and hematocrit during the period when chlorite was used for disinfection. Rats exposed to monochloramine in drinking water at concentrations up to 100 mg per liter for 45 days showed no overt adverse effects. However, patients undergoing kidney dialysis with chloramine-treated water suffered acute hemolytic anemia. The organic reaction products of disinfectants include trihalomethanes, known carcinogens. One study investigated the susceptability of mice to tumors produced by painting the skin with tumor promotors and disinfected Ohio River water concentrated by a factor of 102-186 by reverse osmosis, which does not concentrate trihalomethanes, but higher molecular weight compounds. No tumors were produced by nondisinfected water or water treated with chlorine dioxide plus tumor promotor. Tumors were produced by disinfection reaction products plus tumor promotors as follows: chlorine, 4 of 25 animals; chloramine, 5 of 25 animals; and ozone, 7 of 25 animals. (Cassar-FRC)
W82-04422

EFFECTS OF PETROLEUM HYDROCARBONS ON PLANT LITTER MICROBIOTA IN AN ARCTIC LAKE,
Cincinnati Univ., OH. Dept. of Biological Sciences.
V. L. McKinley, T. W. Federle, and J. R. Vestal.
Applied and Environmental Microbiology, Vol 43, No 1, p 129-135, 1982. 4 Fig, 32 Ref.

Descriptors: *Lakes, *Hydrocarbons, Biomass, Arctic, Polar regions, *Environmental effects, Arctic zone, Microbiological studies, Leaves, Microorganisms, Plant litter, Oil, *Toolik Lake, *Alaska.

The short term effects of Prudhoe Bay crude oil, diesel fuel, and toluene on microbial adenosine triphosphate (ATP) levels and the rate of acetate incorporation into microbial lipids on colonized Carex sedge leaf litter were examined. Study was also made of the effects of Prudhoe Bay crude oil, motor oil, diesel fuel, gasoline, hexane, and toluene on Carex lignocellulose mineralization by Toolik Lake sediments. Microbial metabolic activity, measured as the rate of acetate incorporation into lipid, did not vary significantly from controls over a 12 hr period after exposure of colonized Carex litter to 3.0 ml of Prudhoe Bay crude oil, diesel fuel, or toluene per liter. ATP levels were elevated within 2 hr after exposure to diesel fuel or toluene, but returned to control levels after 4 to 8 hr. Mineralization of specifically labeled lignocellulose by Toolik Lake sediments was inhibited 58, 67, 67, and 86% by exposure to diesel fuel, motor oil, gasoline, and toluene, respectively. Hexane-treated samples displayed an increase in the rate of lignocellulose mineralization of 33%. Mineralization of the labeled lignin component of lignocellulose appeared to be more sensitive to hydrocarbon perturbations than was the labeled cellulose component. (Baker-FRC)
W82-04455

EFFECT OF WATER POLLUTANTS AND OTHER CHEMICALS UPON THE ACTIVITY OF LIPASE IN VITRO,
Environmental Research Lab.-Duluth, MN.
G. M. Christensen, and B. Riedel.
Archives of Environmental Contamination and Toxicology, Vol 10, No 3, p 357-363, 1981. 2 Tab, 9 Ref.

Descriptors: *Pollutants, *Water pollution effects, *Enzymes, Mercury, *Heavy metals, Chemical reactions, *Lipids, Organic compounds, Inorganic compounds, Pesticides.

Lipase is an important lipid enzyme which may be particularly vulnerable to some highly lipid-soluble environmental chemicals which bioaccumulate in lipid-rich tissue when their rates of degradation or elimination are relatively slow. This study investigated the effects of 100 organic and inorganic chemicals representative of some of the major types of chemical water pollutants on lipase activity. The chemicals tested included thiomides, thiocarbamates, organothiophosphates, urea derivatives, antibiotics and other biocides, aromatic halogenated hydrocarbons, aliphatic halogenated hydrocarbons, phenols and halophenoxy acids, solvents and other industrial chemicals, inorganic salts (both active cations and active anions), organo-metals, carcinogens, and several miscellaneous chemicals. The mercuric ion was found to have the strongest inhibitory effect, followed by other heavy metals, pentachlorophenol, and dicofol. The enzyme was generally found to be relatively highly sensitive to many of the heavy metal cations that are toxic to aquatic animals. Chlorinated phenols and chlorobenzene pesticides were the most inhibiting of the organic chemicals tested, followed by warfarin and malathion. Organometals, phenyl mercuric chloride, and methyl mercuric chloride had intermediate inhibitory effects. Some anions usually considered fairly toxic were found to have only a slight or negligible effect. The four organic carcinogens tested were relatively uninhibiting. The inhibitory effect of a mixture of 10 inorganic salts on lipase was shown to develop through an accumulation of the effects of the components. None of the chemicals studied caused a measurable activation of the enzyme. (Carroll-FRC)
W82-04462

THE RESTORATION OF VEGETATION IN LAKES IN THE PODA LOCALITY NEAR BURGAS AFTER DISCHARGING OF BIOLOGICALLY PURIFIED WASTE WATERS (VUZSTANOVIAVANE NA RADTITELNATA POKRIVKA V SUBIRATELNITE EZERA V MESTNOSSTTA PODA KRAI BURGAS SLED PUSKANETO NA BIOLOGICHNO PRECHISTENI OTPADUCHNI VODI V TIAKH),
Bulgarian Academy of Sciences, Sofia. Inst. of Botany.
I. A. Bondev, and S. Ya. Simeonov.
Ekologiia, Vol 9, p 28-36, September, 1981. 2 Fig, 3 Ref. English Summary.

Descriptors: *Lakes, *Lake restoration, *Macrophytes, Aquatic plants, *Water pollution effects, *Industrial wastes, Petroleum industry, Mapping, Comparative productivity, Bulgaria.

Higher macrophyte vegetation was completely destroyed by dredging operations and oil pollution in the collecting ponds at Poda, which received wastes from a petroleum plant in 1963-1971. Following the construction of a biological treatment plant in 1972, the water purity improved, and gradual restoration of the macrophytes began. The restoration process was followed by mapping, and began in 1973 with the appearance of single Phragmites communis L. at the edges of the lake. In 1974 Typha angustifolia and Bolboschoemus maritimus L. also appeared. By 1978 the vegetation covered 16.2% of the fourth lake. The greatest annual vegetation increase, 8.36%, was seen in 1975. Phragmites communis L. showed the most rapid recovery, accounting for 98.37% of the surface currently covered by vegetation. The stem height and diameter as well as the biological productivity of Phragmites communis were lower than in control lakes. The other two species recovered more slowly.
W82-04476

CYTOGENETIC EFFECTS ON THE EASTERN MUDMINNOW, UMBRA PYGMAEA, EXPOSED TO ETHYL METHANESULFONATE, BENZO(A)PYRENE, AND RIVER WATER,
Nijverheidsorganisatie TNO, Delft (Netherlands).
R. N. Hooftman, and G. J. Vink.
Ecotoxicology and Environmental Safety, Vol 5, No 3, p 261-269, 1981. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Fish, *Mudminnow, *Mutagens, *Water pollution effects, *Ethyl methanesulfonate, Benzopyrene, Rivers, *Rhine River, Bioindicators, Aromatic compounds, Organic compounds.

The eastern mudminnow, Umbra pygmaea, was a suitable bioindicator for detecting cytogenetic effects of chemical pollutants in the aquatic environment. Groups of fish were exposed to two known genotoxic agents, ethyl methanesulfonate and benzo(a)pyrene, and to polluted Rhine River water sampled near Lobith, the Netherlands. Best results were obtained with gill tissue after 2 injections with bromodeoxyuridine. Chromosome damage was found in fin and gill tissue. Chromatid aberrations were most common, but chromosome breaks were also found. A 2-day exposure to ethyl methanesulfonate at concentrations of 0, 18, 40, and 200 mg per liter produced 0.3, 1.1, 6.8, and 19.6% metaphases with chromosome aberrations, respectively. Benzopyrene at concentrations of 0.00001 mg per liter produced no metaphase aberrations. At the 0.0001 mg per liter level, exposures of 2, 4, and 6 days gave aberrations of 0.3, 1.5, and 1.8%, respectively. Rhine River water caused 0.7, 2.5, and 4.1% metaphases with chromosome aberrations at 8 days exposure to water diluted by high flow, and 8 and 14 days exposure to less diluted low flow water, respectively. Sister chromatid exchange induction analysis after 8 days exposure to Rhine River water produced fin and gill metaphase aberrations of 7.0-8.4% and 5.0-5.2%, respectively, compared with the control, 2.2-2.7%. (Cassar-FRC)
W82-04480

EFFECTS OF LAND USE ON SURFACE-WATER QUALITY IN THE EAST EVERGLADES, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-176520, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-59, 1982. 37 p, 2 Fig, 22 Tab, 7 Ref.

Descriptors: *Land use, *Surface water, *Water quality, *Environmental effects, Agricultural chemicals, Runoff, Wetlands, Nutrients, Data collections, Water pollution effects, Pesticides, Bacteria, *Florida, *Dade County, Everglades.

Water-quality characteristics were determined at five developed areas in the East Everglades, Dade County, Florida, during the 1978 wet season (June through October). These areas are designated as: Coopertown; Chekika Hammock State Park; residential area; rock-plowed tomato field; and Cracker Jack Slough agricultural area. Data from the developed areas were compared with data from four baseline sites in undeveloped areas to determine the effects of land use on the surface-water quality. The rock-plowed tomato field was the only area where surface-water quality was affected. Water quality at this field is affected by agricultural activities and chemical applications as indicated by increased concentrations of orthophosphate, organic nitrogen, organic carbon, copper, manganese, mercury, and potassium. The remaining four areas of land use had water-quality characteristics typical of baseline sites in nearby Northeast Shark River Slough or Taylor Slough. Chemical analyses of soil indicated chlorinated-hydrocarbon insecticide residues at Coopertown and the two agricultural areas, Cracker Jack Slough and the rock-plowed tomato field. Trace elements in concentrations greater than base level occurred at both agricultural areas (manganese), Chekika Hammock State Park (manganese), and at Coopertown (lead and zinc). (USGS)
W82-04491

BIOTA AND BIOLOGICAL PRINCIPLES OF THE AQUATIC ENVIRONMENT.
Geological Survey, Reston, VA. Water Resources Div.
Available from Dist. Branch, USGS 604 South Pickett St. Alexandria, VA 22304. Geological Survey Circular 848-A, 1982. 49 p, 29 Fig, 1 Tab. (Greeson, P.E., editor).

Descriptors: *Biota, *Water quality, *Biological communities, *Aquatic environment, *Water pollution, Environmental effects, Ecosystems, Algae, Streams, Phytoplankton, Invertebrates, Microorganisms, Midges, Water temperature, Channeling, Fauna.

This is the first of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, non-technical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected biota and biological principles of the aquatic environment. Briefing papers are included on 'Why biology in water-quality studies', 'Stream biology', 'Phytoplankton', 'Periphyton', 'Drift organisms in streams', 'Family Chironomidae (Diptera)', 'Influences of water temperature on aquatic biota', and 'Stream channelization: Effects on stream fauna'. (USGS)
W82-04499

MEAN ANNUAL STREAMFLOW OF SELECTED DRAINAGE BASINS IN THE COAL AREA OF SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. F. Ferrieria.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-137696, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-61, October, 1981. 21 p, 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Streamflow, *Coal mines, *Irrigation effects, Evaluation, Forecasting, Flow characteristics, Surface runoff, Land use, Data collections, *Montana, *Fort Union coal region.

Streamflow characteristics of drainage basins within the Forst Union coal region of southeastern Montana were estimated to provide premining data for evaluating the future effects of mining on the environment. Estimated annual mean streamflow at 22 data-collection stations for water years 1975-77 ranged from 0 to 887 cubic feet per second. These estimates are based on miscellaneous-streamflow records at each station and continuous-streamflow records from other stations in the study area. Estimated mean annual streamflow for a 10-year period (water years 1968-77) ranged from 0 to 572 cubic feet per second. These long-term estimates were based on data from stations in the surrounding area having continuous-streamflow records. Estimates mean annual runoff in inches for selected drainage basins within the study area showed no discernible pattern. Many of the drainage basins had a mean annual runoff of less than 0.60 inch; the maximum observed mean annual runoff was 4.45 inches. (USGS)
W82-04506

AN ANNOTATED KEY TO THE IDENTIFICATION OF COMMONLY OCCURRING AND DOMINANT GENERA OF ALGAE OBSERVED IN THE PHYTOPLANKTON OF THE UNITED STATES,
Geological Survey, Reston, VA. Water Resources Div.
P. E. Greeson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.75. Geological Survey Water-Supply Paper 2079, 1982. 138 p, 58 Fig, 4 Tab, 123 Ref.

Descriptors: *Algal, *Phytoplankton, *Taxonomy, *Water quality, Hydrologic data, United States, Genera, *Genera identification.

In early 1979, a retrieval was made for all phytoplankton data contained in the computerized data file of the U.S. Geological Survey. The retrieval revealed the analytical results of 17,959 samples collected and processed between October 1973 and October 1978. Of the approximately 500 genera of fresh-water algae reported in the United States, the U.S. Geological Survey observed 321 genera in the phytoplankton. Fifty-two genera were considered to be commonly occurring and 42 genera were considered to be community dominants. The report lists, describes, and provides a detailed taxonomic key for the identification of 58 genera of algae considered either commonly occurring or dominant. Also included is a summary of environmental conditions under which each algal genus was observed, as well as a glossary and an extensive list of selected references. (USGS)
W82-04524

TOXICITY OF NITRITE TO LARVAE OF THE SALAMANDER AMBYSTOMA TEXANUM,
North Texas State Univ., Denton. Dept. of Biological Sciences.
D. W. Huey, and T. L. Beitinger.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 909-912, 1980. 1 Tab, 16 Ref.

Descriptors: *Nitrites, *Salamanders, *Toxicity, Water pollution effects, Nitrogen compounds, Mortality, Aquatic animals, Texas, Ponds.

Larvae of the salamander, Ambystoma texanum, from a Texas pond were highly sensitive to nitrite in low chloride (5.0 mg per liter) water. The 96 hour LC50 was 1.09 mg per liter nitrite. Nearly 100% mortality was seen at concentrations of 2.5 mg per liter nitrite and above. In water containing 300 mg per liter chloride and 10 mg per liter nitrite, no mortality was observed in 96 hours, probably as a result of lower nitrite uptake rates. (Cassar-FRC)
W82-04529

A METHOD FOR DETERMINING STRESS IN WETLAND PLANT COMMUNITIES FOLLOWING AN OIL SPILL,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. J. Smith, R. D. DeLaune, and W. H. Patrick, Jr.
Environmental Pollution, Series A: Ecological and Biological, Vol 26, No 4, p 297-304, December, 1981. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Marsh plants, *Stress, *Sublethal effects, *Carbon dioxide, Photosynthesis, Toxicity, Marshes, Spartina, Ecosystems, Plant pathology, Wetlands, *Oil spills, Gas chromatography, Water pollution effects, *Ecological effects.

A portable gaseous exchange chamber was developed to measure sublethal stress, such as the effects of oil spills, in wetland plant communities. The system, which requires no on-site electricity, was tested in Louisiana salt marsh on Spartina alterniflora by measuring carbon dioxide fixation rates. Stresses studied were manmade (two concentrations of crude oil) and natural (streamside and inland location). The procedure involved placing light and dark chambers adjacent to each other on marsh plants for about 20 min. Air samples were taken every 5 min and analyzed for carbon dioxide by a gas chromatograph equipped with a flame ionization detector and a catalytic conversion unit to quantitatively reduce CO2 to CH4. The samples were analyzed within 24 hours after collection in an off-site laboratory. After 7 and 14 days exposure the oil-treated plants had fixation rates 19-37% of those in the control plants. In the plants suffering natural water stress, the shorter inland plants had carbon fixations equal to 27-34% of that of the taller streamside plants. (Cassar-FRC)
W82-04548

NITRIFYING POPULATION DENSITIES AND INHIBITION OF AMMONIUM OXIDATION IN NATURAL AND SEWAGE-ENRICHED CYPRESS SWAMPS,
Florida Univ., Gainesville, Dept. of Environmental Engineering.
F. E. Dierberg, and P. L. Brezonik.
Water Research, Vol 16, No 1, p 123-126, January, 1982. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Nitrification, *Wastewater disposal, *Bacteria, Cypress, Water pollution effects, Organic matter, Ammonium, Oxidation, Nitrates, Swamps, Peat, *Florida.

The densities of autotrophic nitrifiers in peat from the floors of cyress domes near Gainesville, Florida, were investigated. One dome received groundwater from a deep artesian aquifer, two were amended with secondary treated sewage effluent, and a fourth was left in the natural state. Nitrifying bacterial densities as determined by the most probable number method (in cells per ml) were as follows: groundwater dome, 78-7900; sewage domes, 350->160,000; and natural dome, 0-56. mmonium concentrations (in mg per liter) were as high as 24.5 in the sewage domes, 3.8 or less in the groundwater dome, and 0.55 or less in the natural dome. Water from the natural dome was used for nitrification rate studies. It was determined that the low pH (4-5) and not dissolved humic materials was responsible for nitrification inhibition. The pH value of the sewage domes was 6-7, more favorable for nitrification. Nitrification inhibition, as seen in natural cypress domes, prevents N losses in these ecosystems because ammonium ion, the dominant inorganic N species, does not leach from the root zone as readily as nitrate. (Cassar-FRC)
W82-04556

SOME EFFECTS OF LAND USE ON BACTERIOLOGICAL WATER QUALITY IN A RECREATIONAL LAKE,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5B.
W82-04567

SYNTHESIS AND DEGRADATION OF CARBOHYDRATES IN THE MARINE PLANKTONIC COMMUNITY OF EUTROPHIC WATERS (SYNTHESE ET DEGRADATION DES COMPOSES GLUCIDIQUES AU SEIN DE LA COMMAUNAUTE PLANCTONIQUE EN ZONE MARINE EUTROPHE),
Arago Lab., Banyuls-sur-Mer (France).
For primary bibliographic entry see Field 5B.
W82-04672

SEASONAL VARIATIONS IN PRIMARY PRODUCTION IN SURFACE WATERS OF THE SAGUENAY RIVER (VARIATIONS SAISONNIERES DE LA PRODUCTION PRIMAIRE DANS LES EAUX DE SURFACE DE LA RIVIERE DU SAGUENAY),
Quebec Univ., Chicoutimi. Dept. des Sciences Pures.
R. Cote.
Hydrobiologia, Vol 83, No 1, p 1-10, 1981. 2 Fig, 3 Tab, 19 Ref. English Summary.

Descriptors: *Water pollution effects, *Primary production, *Seasonal effects, Population dynamics, *Chlorophyll, Rivers, Saguenay River, *Heavy metals, Industrial wastewater, Phytoplankton, Tides, River flow.

Seasonal variability of chlorophyll a and primary production rates were investigated at a station on the Saguenay River near Chicoutimi, May-December, 1978. The annual mean flow in the Saguenay may reach 1300 cu m per sec, and surface tides in the range of 4-6 m are present. At this station, with a maximum water depth of 20 m, the photic zone showed a maximum depth of 2 m. Phosphate levels were very low, with a seasonal mean of 0.02 + or - 0.02 microatom-gram per liter, and nitrates relatively high (mean of 5.6 + or - 0.75 microatom-gram per liter). Seasonal dynamics of the river are characterized by absence of a definite spring bloom, a late growth season, and persistently poor phytoplankton biomasses (chlorophyll a maximum of 3.7 mg per cu m). The maximum production rate was 3.5 mg C per cu m per hr, and the correlation between production rate and biomass was poor. This river flows through an industrialized region and receives effluents from metallurgical plants and paper mills, as well as urban runoff. The presence of trace metals (mercury, copper, lead and iron) may account to some degree for the inhibition of phytoplankton growth. (Carroll-FRC)
W82-04678

MICROBIAL ECOLOGY OF RIVER DEPOSITS IN THE RIVERS KENNET AND THAMES AT READING, ENGLAND,

Lyne and Martin Public Analysts, Reading (England).
R. M. Webster.
Process Biochemistry, Vol 16, No 6, p 12-15, 19, October/November, 1981. 3 Fig, 6 Tab, 24 Ref.

Descriptors: *Detritus, *Microbiological studies, *Aquatic plants, Rivers, *Kennet River, *Thames River, Epiphytes, Actinomycetes, Heterotrophic bacteria, Nutrients, Heavy metals, Algal growth, Aeromonas hydrophila, Toxicity, Indicators, Eutrophication, Water pollution effects, *England.

Surveys were conducted on the microbiology of detritus and sediments of the rivers Kennet and Thames. The first survey, in 1974, estimated populations of algae, fungi, yeasts, blue-green algae and bacteria in different detritus and sediment samples. The second survey, in 1979, estimated the populations of heterotrophic bacteria and actinomycetes on the epiphytic detritus accumulated on the leaves of Nuphar lutea, the yellow water lily, and on the benthic detritus of reed beds, indicated in the first studies as sites of high microbial activity. A simplified succession pattern indicates that peaks of yeasts, blue-green algae, Chromobacterium and total bacteria (by microscopic count) are associated with algal peaks in the summer. Peaks of heterotrophic bacteria and micromonosporas which followed the algal peaks were probably stimulated by decay of the algae. During a bloom the greatest increase in numbers was due to Aeromonas hydrophila. The presence of heavy metals inhibited microbial growth in some of the samples. In addition to relatively high levels in May when the sediments were stirred up, heavy metal levels increased to a peak at the end of October, at which time the number of yellow colonies did not increase with the peak of total heterotrophic bacteria. Although interactions appear to exist between nutritional and metabolic stresses, it seems potentially interesting to use A. hydrophila as a bacterial indicator of organic and heavy metal pollution. The ATP assay could also be used as an indicator of toxicity. (Carroll-FRC)
W82-04688

AN INTEGRATED WATER-QUALITY INDEX FOR IRRIGATION USE,
Central Groundwater Board, Lucknow (India).
B. K. Handa.
Indian Journal of Agricultural Sciences, Vol 51, No 6, p 422-426, June, 1981. 2 Tab, 12 Ref.

Descriptors: *Water quality, *Irrigation water, Monitoring, Salinity, *Soil contamination, *Plant toxins, *Hazardous materials, Water pollution effects, Mathematical studies.

A water quality index has been developed which takes into consideration the effect of various constituents present in water on its use for irrigation. These constituents were divided into two categories: those that are highly toxic to plants and humans, and those that adversely affect soil characteristics and plant growth and are also a health hazard to humans consuming those plants. The latter properties were further subdivided into several subgroups depending on their relative importance, and a ranking factor was assigned to each subgroup in order of importance. For all waters that presented high salinity and other hazards the index was negative. When positive values of the index were obtained, it was taken to indicate that the water so rated could be used for irrigation purposes. The index proved to be quite useful in comparing the overall quality of irrigation water from various sources. The index itself is very flexible and can be modified for various soils, crops, and irrigation techniques. (Baker-FRC)
W82-04723

PESTICIDES IN THE AQUATIC ENVIRONMENT,
Illinois Univ. at Urbana-Champaign.
D. A. Belluck.
PhD Thesis, 1981. 153 p, 15 Fig, 32 Tab, 159 Ref, 7 Illust. University Microfilms International, Ann Arbor, MI; Order No GAX81-14387.

Descriptors: *Aquatic environment, *Pesticides, *Water pollution effects, Aquatic life, Toxicity, Bioassay, Surface water, *Caddisflies, *Eggs, Organochlorine pesticides, Triaenodes tardus, *Illinois, Xenobiotics.

Organochlorine pesticide data of samples obtained from Clear Creek (Southern Illinois) and Lodge Pond (Central Illinois) are presented. Organochlorine pesticide residue levels in organisms from both aquatic communities suggest that residue concentrations may be primarily determined by the habitat and detoxification capabilities (or biological properties) of an organism rather than by its trophic level position. A new bioassay, the caddisfly egg toxicity bioassay, has been developed to measure the effects of zenobiotics on caddisfly embryogenesis. Results from this bioassay indicate that certain insecticides and herbicides are embryotic and/or teratogenic to eggs of the caddisfly, Triaenodes tardus. Bioconcentration of pesticides by T. tardus egg masses is correlated with the physiochemical properties of the pesticide. A strong correlation exists between water solubility and bioconcentration factor. Passive biological system such as caddisfly eggs can accumulate significant quantities of pesticiede from water. Within 24 hours of exposure to radiolabelled pesticides, egg mass pesticide concentrations were at least equal to that in the surrounding water. The caddisfly egg toxicity bioassay provides a quick (three weeks or less), sensitive and inexpensive technique for use by researchers to determine the effects of xenobiotics on aquatic organisms. This new bioassay enables a biologist to test the unique genetic endowment of a local insect population for resistance or susceptibility to a given compound. (Sinha-OEIS)
W82-04727

5D. Waste Treatment Processes

SPECIFIC AND CHELATE EXCHANGERS: NEW FUNCTIONAL POLYMERS FOR WATER AND WASTEWATER TREATMENT,
Water Purification Associates, Cambridge, MA.
For primary bibliographic entry see Field 5F.
W82-04275

EXPERIENCES WITH A PILOT SCALE RESEARCH PLANT FOR PHOSPHATE REMOVAL FROM WASTEWATER WITH ACTIVATED ALUMINA (ERFAHRUNGEN MIT EINER HALBTECHNISCHEN VERSUCHSANLAGE ZUR ABTRENNUNG VON PHOSPHAT AUS ABWASSER MIT AKTIVTONERDE),
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
D. Donnert, S. H. Eberle, P. Gruber, H. Metzger, and H. P. Sapandowski.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 188-193, 1981. 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Phosphate removal, *Adsorbents, Activated alumina, Pilot plants, Process control, Chemical recovery, Regeneration, Aluminum compounds, Advanced wastewater treatment, Germany.

Prior experiments had revealed the potential usefulness of activated alumina for removing phosphate from wastewaters in a form suitable for recovery. A pilot plant was constructed on the experimental field of the Federal Health Bureau in Berlin to test this process on secondary effluent. The plant comprised four stirring reactors with a volume of 0.44 cu m each, of which three were in use for phosphate adsorption while the fourth was being switched to regeneration of activated alumina. Each reactor is filled with 50 kg of activated alumina.. An automatically operating Phosphatometer measures the phosphorus content in the effluent from each reactor, and when the concentration exceeds 1 mg/liter, a process computer switches the reactor over for regeneration with NaOH solution. The intake line is equipped with a turbidimeter to detect sludge influx during heavy rains. A pressure monitor detects obstructions in the process line, and a pH meter regulates carbon dioxide addition for pH adjustment. An effluent turbidimeter indicates alumina carryover. In trials conducted from November 1980 to April 1981, uniform effluent quality was achieved despite influent phosphorus fluctuations. Approximately 40% reductions in COD and 20% reductions in DOC were also achieved in the alumina step. Regeneration efficiencies were only 60% instead of the anticipated 80%; however, this did not greatly increase operating costs. Alumina losses during regeneration were about 4%. Mean effluent concentrations in the range of 0.6-0.7 mg/liter P were obtained over the trial period. (Carroll-FRC)
W82-04280

USE OF STORMWATER DETENTION BASINS FOR NEUTRALIZATION AND SPECIAL TREATMENT OF TOXICANTS (EINSATZ VON REGENKLARBECKEN ZUM AUSGLEICH UND ZUR SONDERBEHANDLUNG TOXISCHER ABWASSERSTOSSE),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Ingenieurbiologie und Biotechnologie des Abwassers.
F. Kast, K. A. Wippler, and L. Hartmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 218-223, 1981. 8 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Toxicity, *Retention basins, *Heavy metals, Sulfides, Chemical precipitation, Iron compounds, Automation, Process control, *Industrial wastewater, Copper, Zinc, Chromium, Cyanide, Biological wastewater treatment, Diversion, Germany.

Studies were conducted from May 1978 to June 1980 at the Geislingen/Steige wastewater treatment plant regarding the possibility of protecting the biological treatment stage from toxicants with the aid of stormwater dention basins. Recurrent reductions in protozoan populations and impariment of activated sludge settling indicated the influx of toxicants into this plant. In many cases, the heavy metal contents of the filter cake and the activated sludge exceeded the permissible levels for agricultural land disposal. A toxicant warning system was installed, consisting of pH, conductivity and temperature sensors, turbidimeter, Toximeter, and photometers for measuring chromium (VI), copper, zinc, cyanide, oils and grasses. If limiting values for any of these indices are exceeded, a slide valve preceding the treatment plant diverts the wastewater into the stormwater detention basin. A procedure for treating the diverted water at reasonable expense was also developed. Sulfide precipitation was the only practical method found for removing copper and zinc, in the presence of complexants, while 97-99% elimination of chromium(VI) was achieved by sequential addition of iron(II) and iron(III) compounds. The diversion technique was judged reasonably effective; however, the high cost of chemical treatment means that this treatment should not be considered a 'normal' part of the wastewater treatment process. Instead, the industrial dischargers must improve effluent quality so that special treatment will only be required in emergencies. (Carroll-FRC)
W82-04282

WASTEWATER TREATMENT WITH ACTIVATED CARBON ADDITION AT THE AERATION STAGE AND SPENT CARBON REGENERATION. (ABWASSERREINIGUNG UNTER ZUGABE VON AKTIVKOHLE IN DIE BELEBUNGSSTUFE UND REGENERIERUNG DER AKTIVKOHLE),
Uhde (Friedrich) G.m.b.H., Dortmund (Germany, F.R.).
K. Eisenacher, U. Neumann, and J. Kelin.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 168-173, 1981. 11 Fig, 2 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Activated carbon, Biological treatment, *Activated sludge process, Organic compounds, Effluents, Recycling, Regeneration, Pilot plants, Germany.

A wastewater discharging concern, a chemical plant construction company, and a research institution performed a cooperative study aimed at demonstrating the advantages of continuous addition of powdered activated carbon in the biological purification of wastewaters containing refractory organic materials. A pilot plant was constructed, treating

wastewater from the Griesheim plant of the Hoechst Co., previously subjected to neutralization and sedimentation. Two activated sludge treatment units were used, one with and one without powdered activated carbon. The wastewater contained aliphatic and aromatic, chlorinated and nitrated organic compounds in amounts varying with production demand. Effluent TOC values of 175-355 mg/liter were attained following activated sludge treatment without active carbon, compared to values of 50-128 mg/liter for fresh active carbon addition at 100 mg/liter of wastewater. A visible improvement in effluent clarity was achieved. During some experimental periods, normal operation of the biological treatment plant without carbon addition was impossible. To reduce the cost of treatment, an experimental carbon regeneration plant was constructed. The mixture of excess sludge, spent carbon and wastewater was collected, mechanically dewatered, and the carbon regenerated. Adequate reactivation was accomplished for several cycles by desorption with stream at 150-200 degrees C, but then a more rigorous treatment was required, comprising desorption at higher temperatures and reactivation in an inert gas (fluidized sand bed) at temperatures above 800 degrees C. (Carroll-FRC)
W82-04283

COMBINATION OF MACROPOROUS RESINS AND ACTIVATED CARBON IN ADVANCED WASTEWATER TREATMENT. (KOMBINATION VON MAKROPOROSEN ADSORBERHARZEN MIT AKTIVKOHLE ZUR WEITERGEHENDEN ABWASSERREINIGUNG),
Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. Ruffer, and T. Slomka.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 176-180, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Resins, Municipal wastewaters, Organic compounds, Recycling, Regeneration, Filtration, Total organic carbon, *Macroporous resins.

Combining weakly basic ion exchange resins and active carbon for treatment of municipal wastewaters would reduce costs by prolonging carbon life and increasing adsorber performance. A test system was constructed comprising multilayer (gravel/sand/anthracite) filtration, macroporous resin adsorption, and activated carbon adsorption, with the possibility of removing samples for analysis after each treatment stage. A high-quality regenerable carbon produced more complete removal of organic materials than an inexpensive, disposable carbon. Using a biologically pretreated feed water, the initial TOC 26.4 mg/l decreased to 20.6 g/liter following filtration, 11.8 mg/liter following resin adsorption, and 6.14 mg/l after treatment with the regenerable carbon. Effluent quality remained constant up to the breakthrough point of the column, which was reached after 6000 bed volumes had passed through. Subsequent chlorination gave water of excellent quality for industrial use. The problem of disposal and cost of the regenerant solution had previously interfered with practical use of resin adsorption. The regeneration eluate should not be discarded, as it can be reused up to 8 times. Eluate volume for disposal was reduced to about 1 cu m/10,000 cu m of wastewater treated by allowing a diffusion interval, i.e., allowing the regenerant to remain in contact with the resin for a few hours early in the regeneration process. The most heavily contaminated regenerant fractions were discharged to the biological water treatment plant, and the remainder reused. (Carroll-FRC)
W82-04284

CHRYSLER UPGRADES OILY WASTES TREATMENT IN KOKOMO,
Chrysler Corp., Kokomo, IN.
B. D. Harlow, and T. M. Doran.
Industrial Wastes, Vol 27, No 6, p 24-27, November/December 1981. 2 Fig, 2 Tab.

Descriptors: *Industrial wastewater, *Oily water, *Wastewater treatment, Freon, *Separation techniques, *Metal-finishing wastes, Chrysler Corporation.

The Chrysler Corporation plant in Kokomo, Indiana, has upgraded its waste treatment plant to reduce the concentration of freon extractable compounds to less than 50 mg per liter prior to discharge into the city sewer system. The facility makes and assembles cast aluminum transmission parts. These processes require large quantities of oil. Problems with the original treatment facilities were inadequate batch tank capacity, inefficient chemical feed system, only a single flotation unit, necessity for a separate low grade oil processing system, and a large volume of water. Modifications included use of an emulsion breaker, addition of a batch treatment tank, oil/water separator tank, oil pre-heat tanks, and filtered oil tank; pH adjustment; and elimination of a flotation unit and oil cookers. Reclaimed oil is sent elsewhere for additional refining or storage on-site. current effluent freon extractables are 21 mg per liter compared with 80 mg per liter in 1976. The volume of liquid treated has been reduced from 10.8 million gal per month to 7.6 gal per month, alum dose from 602 to 58 mg per liter, polymer dose from 9.7 to 1 mg per liter, chemical costs from $11,573 to $2,437 per month, and cost per 1000 gal from $1.07 to 33 cents. No waste oils are generated by the modified process, whereas 10,000 gal per week were formerly produced for disposal at 10 cents per gal. (Cassar-FRC)
W82-04285

IMPACT OF PHOSPHORUS REMOVAL AT THE DANBURY, CONNECTICUT SEWAGE TREATMENT PLANT ON WATER QUALITY IN LAKE LILLINONAH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Water, Air, and Soil Pollution, Vol 16, No 4, p 511-531, 1981. 12 Fig, 5 Tab, 14 Ref.

Descriptors: *Water quality, *Phosphorus removal, *Water treatment facilities, Eutrophication, Lakes, Rivers, *Lake Lillinonah, Housatonic River, Filtration, *Danbury, Connecticut, *Wastewater treatment, Lake restoration.

This paper presents an independent assessment of the results of the FMC Corporation's limnological surveys made of Lake Lillinonah and Lake Zoar, an impoundment just downstream from Lake Lillinonah, and their major tributaries during the summers of 1976 and 1977. The surveys provide data which should help evaluate the effect of phosphorus removal at the Danbury wastewater treatment plant on water quality in the two lakes. The data revealed an apparent improvement in Lake Lillinonah water quality between the two years which might be related to phosphorus removal at the Danbury treatment plant. Phosphorus load was reduced from 13600 to 6700 kg/year in 1976 and 1977, respectively. The flows of the Housatonic River in 1976 and 1977 were also dissimilar: in 1977 about twice as much water entered Lake Lillinonah as in the former year. The eutrophication study results were used to estimate the impact of flow and altered phosphorus loads on Lake Lillinonah's eutrophication-related water quality. The average planktonic algal chlorophyll concentration would have been reduced from 35 to 30 micrograms/liter if the flows of the Housatonic River were to have been the same during the two years of the study. (Baker-FRC)
W82-04298

DESIGN MODELS FOR ADSOPRTION SYSTEMS IN WASTEWATER TREATMENT,
Queen's Univ., Belfast (Northern Ireland). Dept. of Industrial Chemistry.
G. McKay.
Journal of Chemical Technology and Biotechnology, Vol 13, No 2, p 717-731, 1981. 12 Fig, 69 Ref.

Descriptors: *Design criteria, *Water treatment facilities, Wastewater treatment, Mathematical models, Model studies, Simulation, Adsorption, Industrial wastes, Effluents.

Various methods of solid-liquid contacting in adsorption systems have been considered. High mass-transfer rates are obtained in fluidized bed systems, and small adsorbent particles may be used, giving a large external surface area for adsoprtion. The control of such systems is more difficult than of a fixed-bed column, and there is a lack of flexibility in operation. Fixed-bed adsorbers are most widely used, and the effluent continuously comes into contact with fresh adsorbent. Therefore the driving force to each equilibrium is high. In batch processes a relatively long contact time is needed to reach equilibrium and a further solid-liquid separation stage is needed at the end of the process. The selection of the correct adsorbent, the method of contacting and the regeneration system determine the economics of adsorption systems. Various methods of designing adsorption systems for wastewater treatment have been considered. The design of the reactivation unit is considered, and the technique of minimizing the cost of adsorption plants is discussed. It is usually wise in the design of wastewater treatment plants to allow some overdesign to account for certain factors, including flow rate surges, changes in feed concentration, increases in throughput requirements or increased levels of effluent quality, and for decreased adsorbent performance due to numerous reactivations. (Baker-FRC)
W82-04300

WATER TREATMENT AT HOMESTAKE'S BULLDOG MOUNTAIN OPERATION,
Homestake Mining Co., Creede, CO.
J. L. Young, and R. A. Bohling.
Mining Engineering, Vol 33, No 12, p 1689-1691, December, 1981. 4 Fig.

Descriptors: *Wastewater treatment, *Mine drainage, *Heavy metals, *Water quality standards, Hydrogen ion concentration, Mine wastes, Silver, Lead, Metals, Wastewater facilities, Aeration, Clarification, Filtration, Sand filters, *Colorado.

In 1977, a mine water treatment plant was constructed for Homestake's Bulldog Mountain silver and lead mines to keep discharge waters in line with National Pollutant Discharge Elimination System regulations. In 1980, construction began on a wastewater treatment plant. During treatment, mine discharge is first metered and then passed to the aeration stage. Metals are precipitated in a clarifier as hydroxides at pH 9.5-10.0 regulated by lime solution. The clarified effluent is sent to a splitter, where part of the stream may be treated by sand filtration. Sulfuric acid is used to make final pH adjustments to 6.0-9.0. Initial plant start-up problems were encountered with maintaining clarifier and final pH, effective lime pumping, and sludge removal. Most control problems were solved by a programmable Taylor 1380R adaptable gain controller. Daily assays from the plant show good compliance of discharge with permit parameters. High copper levels are occassionally encountered and are treated with hydrogen perioxide. Tests are in progress to study the feasibility of using O2 in place of sulfuric acid for effluent pH adjustment. (Geiger-FRC)
W82-04311

ZERO-DISCHARGE IN PRACTICE AT RAY D. NIXON POWER PLANT,
Ray D. Nixon Power Plant Water Supply, Colorado Springs, CO.
W. D. Givens, F. K. Marotte, and C. T. Zeien.
Industrial Water Engineering, Vol 18, No 5 p 20-25, September/October, 1981. 8 Fig.

Descriptors: *Cooling water, *Powerplants, *Water reuse, Water treatment, *Wastewater treatment, Water management, Water softening, Industrial wastewater, Algicides, Reverse osmosis, Evaporation, Ash, Solid waste disposal, Waste disposal, Water conservation, *Coal, Fuel, Water pollution prevention, Zero discharge, Colorado.

The Ray D. Nixon coal-fired power plant near Colorado Springs, Colorado, has successfully practiced zero-discharge water management since its opening in April 1980. The water comes from eight wells above a small brackish aquifer, which is

recharged from a nearby creek. Water softening by sodium-base ion exchange reduces the hardness. The treated water is stored in a 5.2 million gal steel reservoir until needed. Wastewater streams are equalized in a 10 million gal clay lined basin with 2 week detention time. Algae are controlled with simazine. The automated filtration system consists of three package units with capacities of 300 gpm each. Ferric chloride and a cationic polymer are used as flocculators. A 120,000 gal clear well provides filter backwash water and cushions flow changes. The remainder of the water treatment system consists of reverse osmosis, evaporators, decant basins, and evaporation ponds. (Cassar-FRC)
W82-04320

RECYCLING ALLOWS ZERO POWERPLANT WASTEWATER DISCHARGE,
B. B. Hall, and L. Stierwalt.
Industrial Water Engineering, Vol 18, No 5, p 26-30, September/October, 1981. 1 Fig, 5 Tab.

Descriptors: *Cooling water, *Powerplants, *Water reuse, *Wastewater treatment, Industrial wastewater, Water management, Ash, Solid waste disposal, *Waste disposal, Water conservation, Water pollution prevention, Clarifiers, Martin Drake Power Station, *Colorado Springs, Colorado, Zero discharge.

A zero discharge plant was designed for the coal-fired Martin Drake Power Station, Colorado Springs, Colorado, to comply with environmental regulations. A dual treatment system with limited interconnections was selected, one system to process ash transport water and the other to process cooling water blowdown. Fly ash and bottom ash are sent via the existing hydraulic transport system to new clarifiers for gavity settling. The ash transport water is reused for transporting more ash. Settled ash is trucked to a landfill. Cooling tower blowdown is treated with a cold lime-soda ash softening process to control Ca, Mg, and silica followed by clarification, filtration through dual sand-anthracite media, and pH adjustment. Sludge is added to the ash treatment process, and water is returned to the cooling system. (Cassar-FRC)
W82-04323

SHAKING DOWN A SOLIDS HANDLING SYSTEM,
Greater Lawrence Sanitary District, North Andover, MA.
E. Teittinen.
Water/Engineering and Management, Vol 129, No 1, p 45-46, January, 1982. 2 Fig.

Descriptors: *Wastewater facilities *Sludge solids, Treatment plants, *Water treatment facilities, Filters, Pumps, Clogging, Springs, Fibers, Industrial wastes, Textile mill wastes, Waste disposal, Solid wastes.

Problems which occurred during the start-up of a solids handling system in North Andover, Massachusetts are reviewed. Early problems were noted in the development of the vacuum filter operation; these were overcome. At the start, running the vacuum filters with only a primary sludge feed was trouble-free. This ended when activated sludge was generated and mixed with primary. The system's ability to keep pace with the solids being produced became severely limited, and an intensive diagnostic program was begun. Problems were identified in the spring gap and sprays, following which steps had to be taken to ensure that coil integrity would be maintained after they were refurbished. A final refinement in the vacuum filter operation was achieved when ferric chloride and lime were replaced with polymers as dewatering aids. Material handling had been simplified by converting an unused sodium hypochlorite storage tank to bulk polymer storage. In addition to labor savings, significant reductions were realized in processing chemical costs. While there was no reduction in cake solids content due to the conversion, there was a significant increase in volatile solids (65-75%) and a reduction in ash volume for disposal. (Baker-FRC)
W82-04338

DISSOLVED OXYGEN CONTENT MONITORING USING GAS PHASE OXYGEN ANALYSIS IN A HIGH PURITY OXYGEN ACTIVATED SLUDGE PLANT,
Yokohama Sewerage Bureau, Kawasaki (Japan).
Y. Kurokawa, Y. Nameda, Y. Itoh, T. Katoh, and R. Tanuma.
Water Science and Technology, Vol 13, No 9, p 293-298, 1981. 3 Fig, 3 Ref.

Descriptors: *Activated sludge process, *Oxygenation, *Monitoring, Dissolved oxygen, Wastewater treatment, Oxygen transfer, Aeration, *Kawasaki, *Japan.

Dissolved oxygen control in a high purity oxygen activated sludge plant was achieved by monitoring the partial oxygen pressure in the vapor phase and the water temperature. Values calculated from this procedure compared well with measured dissolved oxygen concentrations from April 17 to December 30 at the 1500 cu m per day Ikuta sewage treatment plant, Kawasaki, Japan. A dissolved oxygen rate of 20 mg per liter was found suitable for this plant. Further increases in dissolved oxygen levels did not consistently improve treated water quality. (Cassar-FRC)
W82-04344

A TREATMENT SYSTEM FOR AN ORGANIC CHEMICALS PLANT,
Allied Chemical Company, Danville, IL.
N. L. Lanter, and D. L. Hatfield.
Industrial Wastes, Vol 27, No 6, p 22-23, November/December, 1981. 1 Fig, 1 Tab.

Descriptors: *Chemical wastewater, *Organic compounds, *Chlorinated hydrocarbons, *Wastewater treatment, *Industrial wastewater, Carbon tetrachloride, Acidic water, Sodium hypochlorite, Sedimentation, Chemical wastewater.

The Allied Chemical Company plant at Danville, Illinois, treats six wastewater streams individually before combining them for suspended solids removal and discharge into the city sewer system. The basic process involves reaction of carbon tetrachloride with hydrofluoric acid, using the additional raw materials sulfuric acid, hydrochloric acid, hydrocarbons, finishing agents, sodium hydroxide, and heavy metals. The six wastewater streams are as follows: (1) weak sodium hypochlorite solution, (2) chlorocarbons and chlorofluorocarbons, (3) acidic water containing fluorocarbons, (4) colling tower and boiler blowdown, and (5) and (6) acidic water with up to 50% total suspended solids. Sanitary waste and stream (4) are discharged directly into the sewer. Noncontaminated storm water is transported off-site. Stream (1) treatment catalytically decomposes sodium hypochlorite into oxygen and chloride. Stream (2) treatment involves settling chlorocarbons and separation in a tank; Stream (3) is sent directly to the combined final treatment. The high solids (5) and (6) wastewaters are subjected to sedimentation in the containment vessels. Terminal combined treatment consists of two sedimentation steps and filtration followed by discharge into the sewer. (Cassar-FRC)
W82-04353

AMERICAN HOECHST UPGRADES A TREATMENT SYSTEM THROUGH AUTOMATION,
American Hoechst Corp., Leominister, MA.
V. M. DiTaranto, Jr.
Industrial Wastes, Vol 27, No 6, p 28, 31-33, November/December, 1981. 2 Fig, 2 Tab.

Descriptors: *Heavy metals, *Metal-finishing wastes, *Automation, *Sludge drying, *Wastewater treatment, Nickel, Copper, Zinc, American Hoechst Corporation, Industrial wastewater, Chemical wastewater, Electroplating.

Pretreatment of electroplating wastewater removes 96% total suspended solids, 97% nickel, and 98% zinc at the American Hoechst plastics manufacturing facility at Leominster, Massachusetts. The effluent is then combined with wastewater from the styrene polymerization process for further treatment. The system uses lime neutralization, ferric sulfate coagulation, flocculation, sedimentation, sludge dewatering, and effluent polishing. Influent and effluent metal levels (in mg per liter) average: Cu, 17.2 and 0.9; Ni, 19.2 and 2.4; and Zn, 56.4 and 1.3. Much of the system is automatically controlled, including start-up and shutdown, level control, pH control, sludge centrifugation, and monitoring. (Cassar-FRC)
W82-04354

OPERATIONAL PERFORMANCE OF AN RBC UNIT IN CONJUNCTION WITH A SEPTIC TANK,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
J. W. Atwater, and G. Bradshaw.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 477-483, December, 1981. 7 Fig, 11 Ref.

Descriptors: *Septic tanks, *Solids contact processes, *Primary wastewater treatment, Wastewater treatment, Rotating biological contactors, Biological treatment, Performance evaluation, Denitrification, Oxidation, Nitrogen removal, *British Columbia.

Data collected from the wastewater system operation at a 60-man prison camp near Agassiz, British Columbia, was analyzed. The system consisted of a rotating biological contactor in series with a septic tank for primary solids removal and sludge storage. A secondary clarifier sent sludge back to the septic tank for recycling. Chlorination and three days of lagooning were followed by discharge of effluent into a stream. An initial odor problem was solved by recycling effluent from the last stage of the contactor back to the septic tank. This system produced an effluent acceptable by federal guidelines, 20 mg per liter for BOD and 25 mg per liter for suspended solids. Effluent quality degenerated if solids were not removed from the septic tank within 12 months. Data suggest that the required surface area for rotating biological contactors operating with primary treatment by septic tanks is three times that using conventional primary treatment. Denitrification occurred concurrently with carbonaceous oxidation. (Cassar-FRC)
W82-04355

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATER--IV. CONCLUSIONS, DESIGN AND OPERATIONAL CONSIDERATIONS FOR ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
M. S. Gordon, D. J. Chapman, L. Y. Kawasaki, E. Tarifeno-Silva, and D. P. Yu.
Water Research, Vol 16, No 1, p 67-71, January, 1982. 10 Ref.

Descriptors: *Aquaculture, *Tertiary wastewater treatment, Wastewater treatment, *Recycling, *Nutrients, Design criteria, Heavy metals, Metals, *Food chains, Fate of pollutants, Effluents, Bioaccumulation, Accumulation, Nutrient removal, Cultures, Algal growth, Algae, Scenedesmus, Cladocerans, Crustaceans, Fish, Daphnia, Chlorophyta, Shinrs, Fathead minnows, Carp.

This paper summarizes the results of three previous papers on growing food chains in secondary wastewater for the purposes of tertiary wastewater treatment in effluent which has been chlorinated, then dechlorinated. The food chains consisted of unicellular green algae, herbivorous cladocerans or fish, and carnivorous fish, followed in som cases by filamentous green algae. Aspects studied in the first three papers were nutrient uptake, biological productivity, and heavy metal accumulation. Some general conclusions are drawn in this paper. This process is feasible for reducing effluent nutrient loading and for growing usable crops of organisms in sunny, temperate regions. Batch cultures are reliable, but continuous cultures are not likely to be usable without pH control. A near-neutral pH will produce high densities of suspended algal cells, while absence of pH control will produce clumped cells for easy harvesting. These aquaculture operations are best suited to rural and suburban areas,

where competition for land use is not too great. (Cassar-FRC)
W82-04369

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS--III. UPTAKE OF DISSOLVED HEAVY METALS BY ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
E. Tarifeno-Silva, L. Y. Kawasaki, D. P. Yu, M. S. Gordon, and D. J. Chapman.
Water Research, Vol 16, No 1, p 59-65, January, 1982. 9 Tab, 23 Ref.

Descriptors: *Aquaculture, *Tertiary wastewater treatment, *Heavy metals, *Accumulation, *Nutrients, Fate of pollutants, *Food chains, Cultures, Wastewater treatment, Metals, *Recycling, Effluents, Bioaccumulation, Algae, Chlorophyta, Scenedesmus, Cladocerans, Daphnia, Fish, Notemigonus, Pimephales, Shiners, Fathead minnows.

Concentrations of 15 heavy metals (Ba, Cd, Co, Cr, Cu, Fe, Mn,Mo,Ni, Pb, Sn, Sr, Ti, V, Zn) accumulating in an algae algae-cladoceran-fish food chain growing in secondary wastewater effluent were reported. The food chain consisted of Scenedesmus (algae); Daphnia magna and Daphnia pulex (cladocerans); and Notemigonus crysoleucas and Pimephales promelas (fish). Concentration factors were higher in algae (500-30,000) than in Daphnia (30-6000) and fish (4-1600). The concentrations of metals found in algal cells depended on buffering and presence of ferrous sulfate. Relative abundances of metals in algae were substantially different from the abundances in effluent. Concentrations of metals in cladocerans were 2 to 50% of those in algal cells. Relative abundance differed between algae and Daphnia and between Daphnia magna and Daphnia pulex. Most elements were either equal in both species or higher in Daphnia magna than in Daphnia pulex. For 7 of 9 metals fish showed lower metal concentrations in muscles than the Daphnia they ate. Relative abundances of the metals differed between the two fish species. (Cassar-FRC)
W82-04370

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS--I. NUTRIENT UPTAKE AND RELEASE BY ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
L. Y. Kawasaki, W. Tarifeno-Silva, D. P. Yu, M. S. Gordon, and D. J. Chapman.
Water Research, Vol 16, No 1, p 37-49, January, 1982. 2 Fig, 8 Tab, 55 Ref.

Descriptors: *Tertiary wastewater treatment, *Nutrient removal, *Recycling, *Aquaculture, Wastewater treatment, Algal growth, Algal harvesting, Fish, Cladocerans, Algae, Chlorophyta, *Food chains, Nitrates, Phosphates, Effluents, Nitrogen removal, Phosphorus removal, Cultures, Scenedesmus, Cladophora, Ulothrix, Daphnia, Notemigonus crysoleucas, Pimephales promelas, Notropis lutrensis, Carp, Shiners, Fathead minnows, *Water reuse.

The nutrient (nitrate and phosphate) dynamics of each stage in artificial food chains was investigated in a secondary wastewater effluent for the purpose of producing a tertiary-treated effluent. Suitable organisms were Scenedesmus, a unicellular green alga; Cladophora and Ulothrix, filamentous green algae; Daphnia magna and Daphnia pulex, cladocerans; and Notemigonus crysoleucas, Pimephales promelas, and Notropis lutrensis, fish. Addition of 1 ppm ferrous iron and 5% carbon dioxide were required to provide good algal growth for the cladocerans' food supply. Nitrate and phosphate removals in buffered algal cultures were 78% and 55%, respectively; in unbuffered algal cultures, 30% and 98%, respectively. The high removal of phosphate in the unbuffered cultures was probably a result of precipitation of phosphate at the high pH levels. The cladocerans and fish returned ammonia and phosphate to the effluent. These were removed in the final stage by filamentous green algae. Continuous light conditions were more conducive to nutrient removal than a 12 hour light-12 hour dark cycle. Daily harvesting rates of 25-75% of culture volumes did not significantly affect nitrate removals in buffered algal cultures, but phosphate removals were inversely proportional to harvesting rates. (Cassar-FRC)
W82-04371

DESTABILIZATION OF BIOLOGICAL SOLIDS WITH FERRIC CHLORIDE,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
A. C. Chao, and T. M. Keinath.
Water Research, Vol 16, No 1, p 23-30, January, 1982. 10 Fig, 1 Tab, 20 Ref.

Descriptors: *Activated sludge process, *Coagulation, *Ferric chloride, Wastewater treatment, Flocculation, Suspended solids, Organic matter, Hydrogen ion concentration, Microorganisms.

A two-step pH control method is given for coagulating suspended biological solids produced during upsets in the activated sludge process. This situation is characterized by high levels of sludge pinpoint flocs and dispersed cells. In ferric chloride coagulation the flocs are readily removed at low dose levels, but the cells, only a small percentage of the total suspended solids, require a much higher dose of coagulant for complete removal. In the two-step method, ferric chloride is added quickly so that solution pH drops to 3-4. During this low pH period the ferric chloride is in soluble form, effectively sorbed by biological particles. After 20 sec mixing, the pH is adjusted to 5.0. Then the soluble ferric chloride species polymerizes, forming insoluble bridges more evenly sorbed by solids than those produced by the constant pH method. This method removed 13 mg per liter biological solids with 1 mg per liter ferric chloride, a 25% savings in chemical over the constant pH method. (Cassar-FRC)
W82-04373

ON THE MARGINAL COST OF WASTEWATER SERVICES,
President's Council of Economic Advisers, Washington, DC.
For primary bibliographic entry see Field 6C.
W82-04376

WASTEWATER DECHLORINATION STATE-OF-THE-ART FIELD SURVEY AND PILOT STUDIES,
Los Angeles County Sanitation Districts, Whittier, CA.
C. Chen, and H. B. Gan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102336, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-169, October 1981. 5 p, 6 Fig. 14-12-150, 68-03-2745.

Descriptors: *Wastewater treatment, *Dechlorination, *Activated carbon, *Sulfur dioxide, *Holding tanks, *Cost analysis, Residual chlorine, Coliforms, Effluents, Aeration, Bacteria, chemical treatment, Disinfection, Los Angeles county, California.

A study of dechlorination was conducted in the County Sanitation Districts of Los Angeles County to determine the utility and efficiency of the sulfur dioxide method and to provide a cost-effective comparison of sulfur dioxide and two other methods of dechlorination, namely, activated carbon and holding tank processes. Pilot-scale testing indicated that no degradation of physical and chemical water quality occurred in the dechlorinated effluents from any of the three dechlorination processes investigated. However, a one to two order of magnitude increase in total coliform density in the 10-minute samples following cechlorination was commonly observed among the three dechlorination processes. The increase seemed to originate from contamination by the existing microorganism communities in the dechlorinated effluent rather than from the reactivation of injured bacterial cells. A field survey involved the canvassing of 55 operating plants in California by mail, telephone, and site visits to selected facilities. The feed forward method of sulfur dioxide dosage control with signals received from both a flow and residual chlorine controller appeared to be the most commonly employed method. Although overdosing of sulfur dioxide was frequently necessary to meet the residual chlorine discharge standards, most installations found pH adjustment and reaeration of the dechlorinated effluent unnecessary. Process cost estimates based on the field survey and pilot-plant study have been prepared for all three dechlorination processes. The sulfur dioxide process seems to be the most cost-effective method for dechlorination. (Moore-SRC)
W82-04392

PERFORMANCE OF ACTIVATED SLUDGE PROCESSES: RELIABILITY, STABILITY AND VARIABILITY,
Brown and Caldwell, Pasadena, CA.
S. Niku, E. D. Schroeder, G. Tchobanoglous, and F. J. Samaniego.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109604, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-227, December, 1981.11 p, 3 Fig, 6 Tab. R805097-01.

Descriptors: *Wastewater treatment, *Activated sludge process, *Effluents, *Statistical analysis, Standards, Variability, Reliability, Mathematical models, Biochemical oxygen demand, Suspended solids, Effluent variables.

Variations in the daily effluent quality of 43 activated sludge processes were examined. From an analysis of the data, it was found that the effluent variables are not distributed symmetrically, and generally their distributions are skewed further to the right than to the left of the most frequent value. The log-normal distribution was fond to fit the observed effluent biochemical oxygen demand (BOD) and suspended solids (SS) data most consistently. Using the lognormal distribution and a coefficient of reliability (COR), a probabilistic model and design tables and graphs have been developed for predicting achievable effluent BOD and SS concentrations. Mean constituent values are correlated to selected standards with the COR. The proposed model can be used in the design of a treatment process expected to perform at a certain reliability and/or to estimate the reliability of an operating treatment plant. Validity of the reliability model in prediction of effluent quality performance has been verified. The standard deviation was found to be the most appropriate indicator of stability. A standard deviation of 10 g/cu m was selected as stability cut-off point on the basis of a qualitative examination of the data. Plants with effluent values below 10 g/cu m are considered stable; plants with values greater than 10 g/cu m are considered unstable. No single variable or group of variables was found that could be used to characterize the variability of effluent quality for all plants in general. The appropriateness of effluent standards as they are currently stated was discussed, and the use of the geometric mean as a measure of central tendency of daily effluent quality data was recommended for setting discharge standards. (Moore-SRC)
W82-04394

SURVEY AND EVALUATION OF FINE BUBBLE DOME DIFFUSER AERATION EQUIPMENT,
Association of Metroplitan Sewerage Agencies, Washington, DC.
D. H. Houck, and A. G. Boon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105578, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-222, October, 1981. 8 p, 5 Tab. R806990.

Descriptors: *Aerators, *Wastewater treatment, *Oxygen transfer, *Activated sludge process, Maintenance, Cost analysis, Energy, Design criteria.

Aeration equipment employed in activated sludge service is usually the single largest energy consumer in a wastewater treatment plant. Because fine bubble aeration equipment has the potential for markedly higher oxygen transfer efficiencies than coarse bubble designs, its use is rapidly expanding in new or retrofitted treatment plants. In order to assess the long-term oxygen transfer performance, and operation and maintenance history of fine bubble dome diffuser aerators, 19 treatment plants were studied. Thirteen of the plants were in the United Kingdom, two in the Netherlands, and four in the U. S. As nearly as possible, data on influent and effluent wastewater characteristics, power demand, air supply, and process parameters were compiled for a 5-yr period. Maintenance personnel were interviewed to develop a summary of long-term operation and maintenance experience. Specific designs and plant equipment for aeration, air clearing, and diffuser maintenance were studied. Although this survey clearly shows the need for optimized design and operating control strategies to realize the full energy saving potential of this type of equipment, dome diffuser fine bubble aeration systems were providing relatively efficient, low-maintenance service in the plants visited. (Moore-SRC)
W82-04395

DEMONSTRATION PHYSICAL CHEMICAL SEWAGE TREATMENT PLANT UTILIZING BIOLOGICAL NITRIFICATION,
Municipal Environmental Research Lab., Cincinnati, OH.
J. F. Kreissl, and R. F. Lewis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101643, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-173, October, 1981. 7 p, 2 Fig, 2 Tab.

Descriptors: *Physicochemical treatment, *Biological wastewater treatment, *Nitrification, *Wastewater treatment, Domestic wastes, Phosphorus removal, Nitrogen removal, Effluent, Oxygen demand.

This demonstration project was conducted to show that wastewater could be treated in a physical-chemical wastewater treatment plant employing a biological intermediate stage for oxidation of nitrogenous material to produce a high quality effluent and provide different treatment levels to meet a variety of effluent requirements. The physical-chemical plant chosen was of a modular design employing high-rate processes which normally facilitate a relatively speedy installation, a minimum amount of lag time to produce the desired effluent quality, and ease of transport for relocation to other critical areas when needed. The plant was located in the drainage area of a planned residential development known as Beechgrove Village in Kentucky. The wastewater was domestic in nature with no commercial or industrial sources. The removals of BOD5, COD, total organic carbon and suspended solids were excellent. Phosphorus removal was also excellent but the nitrogen removal was rather low. Nitrification never properly developed during the course of the study, even though the nitrogen removals averaged 32%. Although the system produced a consistent, high quality effluent, its utility as a transportable system was only partially demonstrated and its viability as a treatment sequence could not be confirmed due to several design and operational problems. (Moore-SRC)
W82-04397

DESIGN OPTIMIZATION OF THE CHLORINATION PROCESS: VOLUME 1. COMPARISON OF OPTIMIZED PILOT SYSTEM WITH EXISTING FULL-SCALE SYSTEMS,
California Dept. of Health Services, Berkeley.
E. Sepp, and P. Bao.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-100835, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-167, October, 1981. 5 p, 2 Fig, 2 Tab. S-803459.

Descriptors: *Chlorination, *Wastewater treatment, *Disinfection, *Effluents, *Residual chlorine, Coliforms, Toxicity, Pilot plants, Contact time, Mixing, Plug flow, Bacteria, Water pollution control.

Parallel wastewater effluent chlorination studies were done on a mobile optimized chlorination pilot system and the full-scale system at eight different treatment plants. Disinfection efficiency was measured by total coliform enumeration and chlorine residual tests. Parallel flow-through fish bioassays were also conducted at each location. The objectives of the study were as follows: achievement of adequate disinfection with minimum use of chlorine; reduction of chlorine-induced toxicity; and writing of a design manual. At 7 of the 8 plants studied the optimized pilot plant achieved an equivalent level of disinfection with significantly lower chlorine dosage, in some cases more than 50% lower, than the full-scale plants. The pilot plant chlorine residuals were also lower by the same proportions. The reasons for the better pilot plant results were rapid initial mixing, improved chlorine control, and plug flow contact. In most cases the bacterial survival ratio could be expressed as a function of the product of chlorine residual and contact time. There appeared to be, however, a limiting contact time to which this relationship applied. The degree of coliform reduction obtained during initial mixing appeared to be a function of chlorine residual. (Author's abstract)
W82-04399

HOURLY DIURNAL FLOW VARIATIONS IN PUBLICLY-OWNED WASTEWATER TREATMENT FACILITIES,
Weston (Roy F.), Inc., West Chester, PA.
W. H. Chesner, and M. Pai.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107954, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-218, October, 1981. 4 p, 2 Tab. 68-03-2775.

Descriptors: *Flow rate, *Wastewater, *Sewer systems, *Wastewater facilities, *Sewer infiltration, Pumps, Seasonal distribution, Industrial wastewater, *Diurnal distribution, Groundwater level, Design criteria, *Hydraulic design.

Flow variations are rarely addressed in the design of wastewater treatment plants. A survey of 39 sanitary sewer collection systems was undertaken to determine the magnitude of hourly peak flows and to identify the collection system parameters that were most influential in affecting the observed peaks. Significant collection system parameters identified included industrial contribution, average age of the collection system, depth to groundwater, and low-lift, pre-plant pumping stations. Collection systems with industrial or institutional flow contributions greater than 40% were found consistently to have higher daily peak flows than those below 40%. Industrial flows can also be seasonal, with flows during the industrial season resulting in higher peaking factors. Peak flow hours of the day tend to occur at earlier hours in industry-dominated systems. Nonindustrial collection systems with an average age greater than 25 years and high groundwater tables are more susceptible to infiltration, and exhibit higher peaking factors during the spring or infiltration season. The mean average hourly peak flow for nonindustrial systems, excluding inflow, was found to be 1.23 times the annual average daily flow. As collection system flow rate increases, variations around the mean value decrease. Instantaneous maximum peaking factors for low-lit, pump-dominated systems ranged from 1.3 to 4.7, and the minimum instantaneous flow factors varied from 0 to 0.8. (Moore-SRC)
W82-04402

EVALUATION OF ON-SITE WASTEWATER TREATMENT AND DISPOSAL OPTIONS,
Municipal Environmental Research Lab., Cincinnati, OH.
J. A. Heidman, and R. P. G. Bowker.
Available from National Technical Information Service, Springfield, VA 22161 as PB82-101635, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-178, October, 1981. 5 p,1 Tab. 68-03-2627.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Domestic wastes, *On-site systems, *Wastewater management, Literature review, Disinfection, Land disposal, Biological treatment, Physicochemical treatment, Cost analysis, Environmental effects, Soil properties.

A literature review of published and unpublished data was conducted to identify conceivable on-site systems, including wastewater manipulation, treatment, and disposal options. Wastewater manipulation options included flow reduction, wasteload reduction, and waste segregation. Treatment options included disinfection and biological and physical/chemical methods. Disposal options included air, soil, and surface water methods and practical combinations. Both tested and untested systems were identified, and combinations of the various components were developed. An equipment inventory was then performed to determine the availability of hardware for the systems, and system components were identified. Data on engineering, economic, and environmental acceptability characteristics were collected. These systems were evaluated on the basis of performance, operation and maintenance, environmental acceptability, and total annual cost for 15 specific site conditions. Site conditions were defined by soil percolation rate, soil depth, slope, available land area, direct discharge effluent requirements, and net evaporation. Where site conditions are appropriate (conventional septic tank-soil absorption systems) were found to be the least-cost and top-ranked method of on-site wastewater treatment and disposal. Under other conditions, systems incorporating other methods of disposal, such as soil disposal with modified distribution, mounds, evapotranspiration, irrigation, evaporation, or direct discharge, are appropriate. A septic tank normally provides adequate pretreatment for most of these disposal methods. Where irrigation or surface discharge disposal is used, additional treatment, such as that provided by an intermittent sand filter and iodine disinfection, may be required. Use of low pressure membrane filtration where high quality effluent is required also appears promising, based on very limited operating experience.
W82-04404

PRODUCTION ENGINEERING AND MARKETING ANALYSIS OF THE ROTATING DISK EVAPORATOR,
Municipal Environmental Research Lab., Cincinnati, OH.
J. A. Heidman, and R. P. G. Bowker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101676, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-179, October, 1981. 4 p, 1 Fig, 5 Tab. 68-03-2738.

Descriptors: *Wastewater treatment, *On-site systems, *Rotating disk evaporators, *Cost analysis, *Domestic wastes, *Marketing, Climates, Evaporators, Economic aspects, Wastewater disposal.

Recent research into the on-site, mechanical evaporation of wastewater from single family homes revealed that a rotating disk evaporator (RDE) could function in an non-discharging mode. Such a device has potential use where site limitations preclude conventional methods for on-site disposal. A marketing analysis of the RDE defined the market potential, developed a practical design, estimated production and installation costs, and refined market estimates based on cost comparisons. A small unit suitable for only the most favorable climates would have an FOB factory selling price of about $10,000 if fabricated with aluminum disks. Distribution costs and freight will amount to about $3,300. An additional $8,000 is required for installation (including a storage tank), resulting in a total capital cost of about $22,000. Including amortized capital costs, and operating and maintenance costs, an RDE system would treat household wastewater for about 3.4 cents/gallon. Because of these high

costs, the potential RDE market is quite small. It is limited to very expensive homes, second homes with no winter occupancy, and high cash-flow, low sewage-flow commercial establishments. Furthermore, unfavorable climatic conditions eliminate much of the nation from consideration. It is unlikely that manufacturers of RDE systems would collectively generate national sales of 100 units/year. (Moore-SRC)
W82-04405

TREATABILITY STUDIES OF PESTICIDE MANUFACTURING WASTEWATERS,
Research Triangle Inst., Research Triangle Park, NC.
R. Zweidinger, E. Monnig, L. Little, R. Batten, and D. Liverman.
Environmental Protection Agency Project Summary EPA-600/S2-80-077, December, 1981. 4 p, 1 Fig, 3 Ref.

Descriptors: *Pesticides, *Industrial wastes, *Wastewater treatment, *Biological wastewater treatment, Activated sludge process, Fungicides, Herbicides, Insecticides, Carbamate pesticides, Biodegradation, Nitrification.

Laboratory and pilot studies of the treatability of pesticide manufacturing wastewaters were conducted in a project designed to investigate the suitability of individual pesticide manufacturing wastewaters for discharge to biological treatment systems, whether publicly owned treatment works or on-site systems. The pesticides studied were carbaryl, dinoseb, atrazine, dazomet, glyphosate, and an ethylenebisdithiocarbamate fungicide. The approach taken with each pesticide manufacturing wastewater was prioritized; that is, less costly, more available methods of treatment were investigated. The preferred method of treatment was assumed to be biological. Both carbaryl manufacturing wastewater, when mixed 1 part in 9 with muicipal wastewater, and carbaryl itself, spiked at 10 mg/l in municipal wastewater, appear suitable for biological treatment by acclimated systems if additional provision is made for removing ammonia in the effluents from the treatment system. The effluent from the manufacture of dinoseb and atrazine proved suitable for a treatment system involving preliminary activated carbon filtration to remove the herbicide, followed by biological treatment to reduce oxygen demand exerted by solvents and other organic compounds. It is recommended that dazomet wastewater be diluted to at least 1:1000 in municipal wastewater to minimize the negative effects on the nitrification of during the activated sludge treatment process. Biological treatment significantly reduced the toxicity of hlyphosate effluents, but hlyphosate itself showed only partial reduction with treatment (38 to 45%). The presence of ethylenebisdithiocarbamate fungicide manufacturing wastewater strongly inhibits nitrification in activated sludge units. Biological treatment decreased, but failed to eliminate, the amount of ethylenethiourea in the wastewaters. (Moore-SRC)
W82-04406

TREATMENT OF SULFITE EVAPORATION CONDENSATE WITH AN ANAEROBIC REACTOR,
Washington Univ., Seattle. Dept. of Civil Engineering.
M. M. Benjamin, J. F. Ferguson, and M. E. Buggins.
In: Proceedings TAPPI Environmental Conference, 1981, TAPPI Press, Atlanta, Georgia, p 307-316. 6 Fig, 7 Tab, 7 Ref.

Descriptors: *Anaerobic treatment, Methane fermentation, Sulfite evaporator condensate, *Wastewater treatment, *Organic wastes, Sulfur compounds, Toxicity.

A study has been underway since 1979 evaluating the use of submerged anaerobic reactors to treat sulfite evaporator condensate (SEC). Both SEC from a calcium bisulfite mill and a synthetic SEC have been treated at an organic loading of 16 kg COD/m3.d and a detention time of seven hours, achieving 79% to 90% reduction in COD. A yield coefficient of 0.09 gr cells/gr COD removed has been calculated, and the balance of the removed COD is stoichiometrically converted to CH4. Toxicity from sulfur compounds, furfural or trace organics have not been a problem. Partial neutralization of the feed is necessary, as are additions of nitrogen, phosphorus and some trace nutrients. The process produces methane with a significant energy value. In addition, when used as pretreatment, it reduces the energy needed for aerobic treatment.
W82-04419

DEVELOPING AN EFFECTIVE MAINTENANCE PROGRAM PART A: EVALUATION,
Morris Forman Wastewater Treatment Plant, Louisville, KY.
G. R. Freiberg, and W. B. Thompson.
Water/Engineering and Management, Vol 129, No 1, p 30-33, January, 1980. 4 Fig.

Descriptors: *Maintenance, *Wastewater treatment facilities, Maintenance costs, Water treatment facilities, Planning, Management, *Louisville, Kentucky.

Many wastewater treatment facilities have a common problem of spending too much time keeping things running, and not enough time searching for ways to improve operational efficiency. The wastewater treatment plant in Louisville, Kentucky was used to develop an evaluation and implementation procedure for the establishment or upgrading of maintenance systems. The focus of the study was primarily on preventive maintenance, but water and wastewater managers and engineers should find the approach applicable to most maintenance activities. The strengths and weaknesses of each functional area were examined. One major problem which was exposed by this procedure was a substantial spread between estimated and actual costs. Reasons for this appeared to be that either the work was improperly estimated, or workers took too much time and used too much material to complete the task. A review of the existing work order procedure led to a new, more clearly defined set of instructions. Corrective and major maintenance scheduling and planning procedures proved to be ineffective. District-wide accounting and spare parts inventory procedures were included in the study because of their indirect, but critical, effect on the entire maintenance program. The purpose of any maintenance management system is to obtain reliable, efficient, cost-effective service from the equipment. Preventive maintenance is seen as just one element of any comprehensive program. (Baker-FRC)
W82-04447

TERMINAL REACTIONS IN THE ANAEROBIC DIGESTION OF ANIMAL WASTE,
Research Council of Alberta, Edmonton.
D. R. Boone.
Applied and Environmental Microbiology, Vol 43, No 1, p 57-64, 1982. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Anaerobic digestion, *Animal wastes, Organic matter, Biological treatment, *Wastewater treatment, Digestion, Biodegradation.

The terminal reactions of anaerobic digestion were examined to determine whether they are rate limiting. Acetate degradation was measured in digestors which were fed animal waste and in digestors fed animal waste with ultimate methanogenic substrates added continuously to the fermentation. The continuous pumping of acetic acid into the digestor caused an increase in acetate concentration in the effluent which was proportional to the increase in total acetate production, biological production plus amount pumped in. Propionate concentration also increased, perhaps due to product inhibition of propionate-degrading bacteria by the higher levels of acetic acid or due to increased propionate production by fermentative bacteria. When H2/CO2 was the added substrate, there were occasional instabilities in the fermentation immediately after increases in addition rate. The data allow the hypothesis that abrupt changes in digestor influent substrates, which cause a rapid increase in hydrogen production by hydrogen-producing microflora, could create instabilities, causing digestor failure. Digestors with added acetate or H2/CO2 converted at least 95% of the added substrates stoichiometrically to methane, assuming gas production from the animal waste was the same as in controls with no added substrates. Also, volatile solids destruction was similar in the presence and absence of added substrates, suggesting that fermentation of animal waste was not significantly affected by the added load on the methanogenic bacteria. Acetate levels in the digestor with added H2/CO2 were higher, apparently due to both increased acetate production and inhibition of acetate dissimilation. Increases in H2 addition caused temporary instabilities in the fermentation, whereas increases in acetate addition did not. (Baker-FRC)
W82-04454

BIODEGRADATION OF GLYCIDOL AND GLYCIDYL NITRATE,
Army Natick Research and Development Labs., MA.
D. L. Kaplan, J. H. Cornell, and A. M. Kaplan.
Applied and Environmental Microbiology, Vol 43, No 1, p 144-150, 1982. 7 Fig, 13 Ref.

Descriptors: *Nitrates, *Biodegradation, *Organic compounds, *Wastewater treatment, Chemical reactions, Industrial wastes, Biological treatment, Biological wastewater treatment, Nitroglycerine, Mutagens, *Glycidol.

The fate of glycidol and glycidyl nitrate was examined under exposure to microbial activity in order to indicate the feasibility of a biological approach to the decomposition of glycerol trinitrate chemical reaction products. The desensitization of glycerol trinitrate containing waste streams with calcium hydroxide produces the epoxides, glycidol and glycidyl nitrate. Epoxide rings of both compounds are unstable to heat in aqueous solutions. They open to form glycerol 1-mononitrate and presumably glycerol. Microbial activity accelerates these transformations. Glycerol 1-mononitrate was slowly denitrated to form glycerol. Glycidol and glycidyl nitrate caused base pair substitutions in the Ames test for mutagenicity, whereas glycerol 1-mononitrate tests were negative. Biological treatment causes a loss of the mutagenic activity. (Baker-FRC)
W82-04456

PROPORTIONS OF SEVERAL ELEMENTS FOUND IN SEWAGE EFFLUENT AND SLUDGE FROM SEVERAL MUNICIPALITIES IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Div. of Animal and Veterinary Sciences.
For primary bibliographic entry see Field 5B.
W82-04465

THE FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS,
Henkel KGaA, Dusseldorf (Germany, F.C.). Dept. of Ecology.
P. Wierich, and P. Gerike.
Ecotoxicology and Environmental Safety, Vol 5, No 2, p 161-170, 1981. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Adsorption, *Activated sludge process, *Fate of pollutants, Organic compounds, Degradation, Biodegradation, Model studies, Retention time.

A mathematical model was developed to describe the fate of a compound in the activated sludge stage of sewage treatment plants. The compounds under consideration were soluble, nonbiodegradable, and strongly adsorbing. It was concluded that high adsorption in a batch test did not guarantee efficient elimination in a continuous flow activatd sludge process. The effluent concentration reached a limiting value dependent on adsorption constant of the sludge and the surplus sludge wasteage rate. The retention time of the adsorbate exceeded the mean retention time of the sewage and increased with increasing adsorption constant. The maximum

load of the adsorbent on the sludge was lower than the maximum capacity indicated by static batch tests, but it was higher than the influent concentration. The model described in this paper permitted calculation of a base value above which elimination in activated sludge tests was due to biodegradation and not just adsorption. (Cassar-FRC)
W82-04477

MUNICIPAL SEWAGE TREATMENT - SOME RECENT DEVELOPMENTS,
J. M. Sidwick.
Effluent and Water Treatment Journal, Vol 21, No 11, p 501, 503, 505-507, November, 1981. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, Reviews, Sedimentation, Filtration, Activated sludge process, Nitrification, Dissolved oxygen, Anaerobic conditions, Aeronic conditions, Anaerobic digestion, Computers, Automation, *Wastewater management.

Recent developments in the municipal sewage treatment field are discussed. The two most significant trends in primary sedimentation are the increasing use of chemical precipitation and a move toward reducing retention time. Chemical precipitation is being used primarily to remove phosphorus from sewage. Biological filtration has recently been connected with serious odor complications. Part of the problem seems to be the inability of a high rate filter to supply sufficient oxygen to maintain an adequately aerobic biomass, with the consequent development of anaerobic degradation products which escape from the filter aerially or with the wasted sludge. In the conventional activated sludge system the most important new developments relate to the use of this process for nitrogen removal. The chief attraction of biological denitrification is that the nitrogen is completely removed from the system as nitrogen gas without causing atmospheric pollution or a liquor concentrate. Two of the most important recent developments from conventional activated sludge treatment are the use of oxygen-enriched air and the deep shaft process. Biological fluidized beds have only very recently been considered for wastewater treatment. The principle of the fluidized beds is that mixed microbial cultures associated with wastewater have excellent adhesion characteristics. The value of anaerobic treatment has been appreciated for many years, but its application has largely been restricted to sludges and a few particularly strong biodegradable organic industrial effluents. The long retention periods needed for this process have tended to make it costly, and effluents have not been of high quality. Recent advances in the area of instrumentation for automation and control are briefly mentioned. (Baker-FRC)
W82-04528

LABORATORY EXPERIMENTS ON THE PHYSICO-CHEMICAL TREATMENT OF MEAT PROCESSING EFFLUENTS,
Research Inst. for Water Resources Development, Budapest (Hungary).
I. Tookos.
Effluent and Water Treatment Journal, Vol 21, No 11, p 493-500, November, 1981. 6 Fig, 3 Tab, 29 Ref.

Descriptors: *Meat processing industry, *Wastewater treatment, Effluents, Industrial wastes, Chemical coagulation, Separation techniques, Particle size, Colloids, Dissolved organic matter, Chemical engineering, Reviews, Bentonite, *Chemical treatment.

Effluents produced in the course of meat processing operations are highly detrimental, rich in coarse, floating, suspended and dissolved organic pollutants, and have high oxygen demands and unpleasant odors. Intensive mechanical primary treatment processes are effective in removing only coarse pollutants larger than 1-2 mm diameter, but the effluent is still very highly polluted. The physico-chemical treatment of wastewaters produced during the slaughtering and processing of poultry and meat is reviewed. The amount of pollutants removed was found to increase in a linear proportion with the strength of the wastewater treated. A relatively constant treatment efficiency can be expected. Evidently, the same close correlation exists between the raw wastewater and the treated effluent as well. In the case of wastewaters containing particulate matter not larger than 1-2 mm in size, laboratory studies demonstrated that the amount of colloidal substance precipitated did not depend on whether the pollutant was present in suspended form, or in a state which may be regarded as dissolved from the viewpoint of treatment technology. The optimal range of chemical feed rate determined by the laboratory provided no more than preliminary guidance. Higher feed rates may be needed in the interests of precipitate separation if the stability of the resulting sludge is poor. Bentonites alone were ineffective in precipitating colloidal proteins. Results obtained with sulfonic acid were poorer than had been expected. This was due to the carbohydrate content of the coagulant used in the study. The precipitate formed was highly unstable and impossible to remove by sedimentation. (Baker-FRC)
W82-04532

MICROBIOLOGY OF ANAEROBIC DIGESTORS FOR WASTEWATER PURIFICATION. (MICROBIOLOGIE DES DIGESTEURS ANAEROBIES DE L'EPURATION DES EAUX RESIDUAIRES),
Institut National de la Recherche Agronomique, Villeneuve-d' Ascq (France). Station de Technologie Alimentaire.
J. P. Touzel, E. Samain, G. Albagnac, and J. N. Morfaux.
Industries Alimentaires et Agricoles, Vol 98, No 10, p 845-847, 1981. 8 Fig, 3 Tab, 28 Ref. English Summary.

Descriptors: *Bacterial analysis, *Wastewater treatment, *Anaerobic digestion, Microbiological studies, Metabolism, Methane, *Food processing industry, Industrial wastewaters, Organic compounds, Hydrogen.

Detailed information concerning the biochemical characteristics of microbial populations employed in anaerobic digestion aid in optimization of the processes. Studies were performed on laboratory methane digesters treating food processing wastewaters, using recently developed techniques for isolating and growing strictly anaerobic bacteria. The pilot-scale digester was originally inoculated with municipal digester sludge. Media used for enumeration of the total flora and the lactate, propionate and acetate utilizing flora included an all-synthetic reference medium, a rumen fluid medium, a medium based on digester fluid, a medium based on the fluid from the digester from which the flora was taken, and fluid from a municipal digester. The anaerobic precautions employed were adequate to protect the oxygen-sensitive organisms. The predominant bacteria in the total flora were slow growing. The all-synthetic medium seemed to be the medium of choice for total flora enumeration. Presumptive identification was made of the lactate-utilizing strains, the presence of which indicates that the digestion of sugars proceeds through a lactate phase. Acetate enrichment cultures were set up to ascertain the importance of acetate as an intermediate in sugar digestion under the test conditions. After six transfers, bacteria of two principal morphological types were demonstrated: an elongated filament and a sarcina, which were tentatively identified with recently described strains. In propionate enrichment cultures, after four transfers, consumption of propionate and formation of methane were noted. Microscopic observation at this stage revealed the presence of a filamentous bacterium analogous to that obtained on acetate enrichment. Previous studies have shown that degradation of acetate and propionate does not take place in the presence of hydrogen. Hydrogen is therefore being efficiently eliminated from this medium by the methanogenic bacteria. (Carroll-FRC)
W82-04544

INCREASING WASTEWATER TREATMENT EFFICIENCY (UBER DIE ERHOHUNG DES WIRKUNGSGRADES DER ABWASSERREINIGUNG),
P. Benedek.
GWF-Wasser/Abwasser, Vol 122, No 12, p 572-581, 1981. 6 Fig, 10 Tab, 37 Ref. English Summary.

Descriptors: *Wastewater treatment, *Activated sludge process, *Cost effectiveness, Activated carbon, Lake Balaton, *Hungary, Chemical coagulation, Aluminum sulfate, Phosphorus removal, Heavy metals, Organic compounds, Sand filtration, Technology.

In recent years VITUKI, the central research institute of the Hungarian water agency, performed laboratory, pilot and full-scale studies on improvements in wastewater treatment technology. Operating data, cost analyses, and the possibility of process combinations are reported. Heavy metal removal following filtration was found to be poorer in biologically treated wastewater than in the raw wastewater, apparently due to complexation by degradation products. Therefore maximal heavy metal removal prior to biological treatment is important. Providing a mixing pond, prior to the preclarifier, in which the wastewater remains for a few minutes in contact with raw sludge recycled from the preclarifier at the rate of 10-20% would allow precipitation of metals by the sulfides present in the raw sludge. Addition of powdered activated carbon during the activated sludge process was shown to enhance refractory organics removal. Phosphorus elimination, especially important in the case of the Lake Balaton water supply, was accomplished by addition of iron or aluminum sulfate, or with a combination of activated bentonite, aluminum sulfate and polyelectrolytes. Sand filtration guidelines are currently being optimized. Cost comparisons for different combinations of treatment processes showed that the activated sludge process with activated carbon provides greatest cost effectiveness for small and medium sized wastewater treatment plants and can easily be combined with phosphate precipitation by aluminum sulfate. (Carroll-FRC)
W82-04545

THE IMPORTANCE OF THE SOLIDS CONTENT OF THE SLUDGE IN ANAEROBIC ALKALINE DIGESTION (DIE BEDEUTUNG DES FESTSTOFFGEHALTS BEI DER SCHLAMMFAULUNG),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergueteund Abfallwirtschaft.
H. Kapp.
Wasserwirtschaft, Vol 71, No 11, p 319-322, 1981. 3 Fig, 6 Ref. English Summary.

Descriptors: *Mathematical studies, *Anaerobic digestion, *Wastewater treatment, Organic compounds, Sewage gas, Energy conservation, Sludge solids.

Anaerobic digestion has the advantages over aerobic digestion for sewage treatment of lower energy costs (the air supply accounts for 80% of the total energy requirement in an aerobic sewage treatment plant) and production of an off gas usable for heating. Disadvantages include the lability of the process and greater construction costs. A simple equation was developed for assessing the degree of degradation of the organic matter and thus the degree of anaerobic stabilization. Degradation rates of about 50% based on the organic matter supplied are considered normal for municipal sludges. The degree of sludge degradation was plotted against the loss on ignition of the original sludge, using the loss on ignition in the digester sludge as the parameter. This equation and graph should be used for evaluating the digestion results only over long periods (e.g., months), although this is also customary for other methods as well (solids balances). The method is applicable for operation with or without water withdrawal. A pseudo-three-dimensional plot was also developed, relating the initial solids contents, digested sludge solids content, and organic solids fraction in the sludge at different degrees of degradation. (Carroll-FRC)
W82-04549

VARIATION OF SLUDGE VOLUME INDEX WITH ACTIVATED SLUDGE CHARACTERISTICS,
Georgia Inst. of Tech. Atlanta. School of Civil Engineering.
M. Sezgin.
Water Research, Vol 16, No 1, p 83-88, January, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Sludge volume index, *Microorgansims, *Settling velocity, Suspended solids, *Activated sludge, Flocculation, Wastewater treatment, *Wastewater facilities.

Activated sludge samples from two laboratory sources and 12 sewage plants were used to investigate the variation of sludge volume index (SVI) with the quantity of filamentous microorgansims and floc size at different suspended solids concentrations. For a suspended solids concentration range of 700-4800 mg per liter, the SVI increased sharply with filament length concentrations of over 10,000,000 microns per mg suspended solids. At filament length concentrations less than 10,000,000 microns per mg suspended solids, SVI was unaffected by filament length but increased with increasing mean floc size. A well-defined relationship between SVI and zone settling velocity (cm per min) was found at all suspended solids concentrations examined. Maximum attainable SVI varied from 1429 to 208 mg per liter over the suspended solids concentration range, 700-4800 mg per liter. The zone settling velocities corresponding to the maximum attainable SVI were 2 to 0 cm per sec. This relationship was independent of the source and type of sludge, domestic or industrial. (Cassar-FRC)
W82-04555

BENEFITS FROM WATER CONSERVATION DEPEND ON COMPREHENSIVE PLANNING,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3D.
W82-04557

MULTIPERIOD DESIGN OF REGIONAL WASTEWATER SYSTEMS: GENERATING AND EVALUATING ALTERNATIVE PLANTS,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
M. Nakamura, E. D. Brill, Jr., and J. C. Liebman.
Water Resources Research, Vol 17, No 5, p 1339-1348, October, 1981. 8 Fig, 3 Tab, 11 Ref. OWRT A-082-ILL.

Descriptors: *Wastewater treatment, Planning, *Design criteria, Decision making, *Model studies, flow, Network design, *Wastewater facilities.

An extension was prepared of previous works dealing with the generation of single-period alternative solutions and the comparison of alternative regional plans using an impunted value analysis method. The primary purpose of the method is generation of multiperiod locations and facility expansion timings. The method is based on several simplifying assumptions. The solution procedure involves a branch and bound algorithm specifically developed for integrating a set of solutions obtained using the initial design flow with a set of solutions obtained using the terminal design flow. A method for comparing the generated multiperiod alternatives is also presented. The usefulness of the method is demonstrated with an example of a hypothetical regional wastewater system. A Fortran program was written to implement the method. Based on the simplifying assumptions, construction and operating and maintenance costs were reduced to functions of the initial and terminal design year flows, creating two decomposed problems. The two decomposed problems can be tied together using coupling constraints, and a coupled branch and bound process can be sued to obtain solutions. The method can generate many alternative plans besides the approximate least cost solution, and the imputed value incidence matrix can be provided. This approach represents a significant departure from conventional multiperiod public facility location analysis, and may be very useful for analyzing other water resources problems that include concave cost functions. (Baker-FRC)
W82-04562

WATER REUSE PLANNING MODELS: EXTENSIONS AND APPLICATIONS,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-04565

WATER RECYCLING/REUSE IN THE FOOD PROCESSING INDUSTRY,
Montgomery (James), Inc., Walnut Creek, CA.
L. L. Russell, C. Creson, and K. Conarroe.
Industrial Wastes, Vol 27, No 5, p 25-28, September/October, 1981. 3 Fig, 1 Tab. OWRT C-9416.

Descriptors: *Water reuse, *Food processing industry, *Industrial water, Water conservation, Dairy industry, Meat processing industry, Poultry, Sugar refining, Wastewater reclamation, *Wastewater renovation, Wastewater treatment.

An evaluation of 10,000 U.S. food processing plants revealed the potential for water reuse/recycling in this industry. Reuse is defined as treated wastewater recycled within the facility; recycle is defined as multiple use of wastewater within the facility. Time and economic constraints limit a practical implementation to water conservation and recycling for the present. By the year 2000 increased costs and decreased water supplies may necessitate water reuse in some segments of the industry. Health and safety must be carefully considered in water recycling. Fruit and vegetable processing with terminal heat processing are intrinsically safer than meat and poultry packing, where the product is served to the consumer without heat treatment. Small plants will find it less practical to recycle water than large facilities. Water reuse presents further concerns: trihalomethanes production, concentration of pesticides, and pathogenic organisms. Major water-using food industries are sugar refining, canning and preserving fruits and vegetables, grain milling, meat packing, poultry dressing, dairy product manufacture, and beverages. Water reuse facilities at the Snokist Growers fruit processing plant in Yakima, Washington, and the Sterling Poultry Processing Corp., Maryland, are described. (Cassar-FRC)
W82-04566

THE EFFECTS OF PH AND SUSPENDED SOLIDS IN THE REMOVAL OF ORGANICS FROM WATER AND WASTEWATERS BY THE ACTIVATED CARBON ADSORPTION PROCESS,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. J. Martin, and K. O. Iwugo.
Water Research, Vol 16, No 1, p 73-82, January, 1982. 13 Fig, 4 Tab, 32 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Hydrogen ion concentration, *Suspended solids, *Wastewater treatment, Adsorption, Organic matter, Kaolin, Chlorophenol, Cresol, Bromocresol green, Inorganic compounds, Biological treatment, Effluents, Municipal wastewater.

The effects of pH and inorganic and organic suspended solids concentrations on activated carbon adsorption of organic compounds in municipal wastewater and effluents were studied in the laboratory using actual effluents and model solutions. The adsorption capacity and adsorption rate of carbon for o-chlorophenol and o-cresol (molecular weghts, 100-130) and bromocresol green (molecular weight, 700) were not affected by the presence of inorganic suspended solids up to 200 mg per liter kaolin. At the 500 mg per liter level adsorption of only the largest molecule was slightly depressed. The organic suspended solids (mixed liquor volatile suspended solids) at 0-200 mg per liter slightly decreased adsorption rates for the three compounds. At the 200-500 mg per liter concentration of organic suspended solids, adsorption rates for the three molecules were significantly reduced. Adsorption capacity was reduced for the two smaller molecules but not for bromocresol green. In both model solutions and sewage effluents adsorption was strongest in the acidic and basic pH regions (3-5 and 10-11), which favored the highest proportion of undissociated molecules. Although pH adjustment of municipal effluents to aid activated carbon adsorption is not justified, it may have an application in industrial wastewater treatment. (Cassar-FRC)
W82-04568

EVALUATION OF INSTRUMENTS FOR CONTINUOUS ACTIVATED SLUDGE MONITORING,
Environmental Protection Service, Burlington (Ontario). Wastewater Technology Centre.
J. P. Stephenson, E. G. Luxon, B. A. Monaghan, and R. G. Gillespie.
Water Science and Technology, Vol 13, No 11/12, p 721-728, 1981. 10 Fig, 4 Tab, 8 Ref.

Descriptors: *Measuring instruments, *Wastewater treatment, *Monitoring, Acidity, Dissolved oxygen, Suspended solids, Temperature, Flow rates, Organic carbon, *Activated sludge process.

The performance of selected commercial monitoring instruments including those for the measurement of dissolved oxygen, pH, suspended solids, temperature, flow and organic carbon has been evaluated. The pilot plant facilities used consist of two identical parallel activated sludge units with a common primary clarifier, and secondary clarifier surface areas. Degritted raw sewage is fed to the primary clarifier at a constant flow rate with uncontrolled variations in constituent concentrations. Primary effluent and return activated sludge are fed to each biological reactor with a maximum flow of 21.6 cubic meters/day. Diffused air is introduced through perforated PVC piping. Three identical dissolved oxygen instruments were monitored and compared to an air-calibrated reference YSI model 54 oxygen meter. Each instrument performed adequately for 141, 125, and 114 days before attention was needed. Two on-line mixed liquor suspended solids instruments and two RASS instruments were assessed by comparison to reference gravimetric analysis. One on-line self cleaning ISS analyzer and two flow-through ESS analyzers were evaluated by comparison to gravimetric results. The study concluded that suitable instruments exist for continuously monitoring the activated sludge process. The accuracies and instrument standard deviations measured indicate that instruments are sufficiently reliable for continuous monitoring and control functions associated with their use. Adequate maintenance and calibration are required if results are to be acceptable. (Baker-FRC)
W82-04594

DYNAMIC STEP FEED CONTROL FOR ORGANIC CARBON REMOVAL IN A SUSPENDED GROWTH SYSTEM,
Environmental Protection Service, Burlington (Ontario). Wastewater Technology Centre.
L. J. Yust, J. P. Stephenson, and K. L. Murphy.
Water Science and Technology, Vol 13, No 11/12, p 729-736, 1981. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Organic carbon, *Wastewater treatment, Wastewater facilities, Activated sludge process, Oxygen uptake, Process control, Effluent, Effluent variability reduction.

The objective of the present study was to reduce effluent variability from wastewater treatment operations. The study investigated the usefulness of SCOUR control (Specific Oxygen Utilization Rate), which is a dynamic indicator of sludge activity, the nature of pollutants, and the substrate reactor concentration. SCOUR is dependent on both the biological oxygen uptake rate and the concentration of activated sludge in the reactor. SCOUR control was achieved by using the step feed process when compared to a single tank completely-mixed process. Filterable organic carbon effluent data suggest that a reduced effluent variability can be obtained from a SCOUR control strategy during high loading periods. At low loading where SCOUR control was inadequate no improvement of SCOUR or effluent total organic

carbon variability was obtained in comparison with the system consisting of a single compartment completely mixed reactor with recycle. A further modification to the SCOUR controller constraints is required to obtain a unique optimal influent flow distribution if the SCOUR value of a three or more compartment system is to be controlled. The problem of increased effluent suspended solids concentrations must be addressed before SCOUR control can be fully evaluated. The maximum computing time for any one optimization did not exceed 10 minutes, making the iterative control presented acceptable for hydraulic time constants characteristic of the step feed activated sludge process. (Baker-FRC)
W82-04595

CONTROL AND AUTOMATION IN WASTEWATER TREATMENT - ADVANCES, UNSOLVED PROBLEMS AND CHALLENGES,
G. Olsson.
Water Science and Technology, Vol 13, No 11/12, p 826-831, 1981. 15 Ref.

Descriptors: *Wastewater treatment, *Automation, Computers, Reviews, *Activated sludge process, Process control, *Costs, *Operating costs.

A workshop was conducted on improving operation and reducing operating costs at wastewater treatment plants through obtaining a better understanding of the dynamics of the plant and the application of instrumentation and control. The activated sludge process is used as a model for the study, as it forms the heart of most wastewater treatment plants and usually reguires the highest expenditure of energy. A common objective for plant operation is to minimize the variability of the effluent quality. Effluent quality measurements are often crude. More study is also needed in the area of the linkage between sludge retention time and energy demand, settleability, clarifying properties and activity. The sludge blanket level is cricial for the settler and clarifier operation, but varies widely in practice. Many plants are operated so as to keep the mixed liquor suspended solids concentration constant, but there is seldom any apparent reason for doing so. Dissolved oxygen control has been recognized as a rewarding and meaningful control means, from both an economical and biological viewpoint. The availability of good sensors for wastewater treatment is not satisfactory, sometimes due to a lack of knowledge or proper attitude on the part of the user rather than the manufacturer. Extensive research has been performed during the last decade to develop dynamic models for wastewater treatment systems. (Baker-FRC)
W82-04597

AUTOMATIC OPERATION OF A FREEZE-THAWING AND DEWATERING PLANT FOR SEWAGE SLUDGES,
Mitsubishi Electric Corp., Hyogo (Japan).
T. Honda, S. Hiro, and K. Yamanishi.
Water Science and Technology, Vol 13, No 11/12, p 599-604, 1981. 5 Fig, 3 Ref.

Descriptors: *Automation, *Sludge drying, *Sludge thickening, *Freeze drying, Control systems, Process control, Sludge conditioning, Sludge solids, *Wastewater treatment, Hydrogen ion concentration, Pilot plants, Cost savings.

An automatic control system for a freeze-thawing method of sludge dewatering is described. In the freeze-thawing method, agglomeration of solid sludge occurs during freezing, and the specific filtration resistance is decreased from 10,000 m/kg to 10 to the 12th power m/kg. This allows reductions in sludge moisture content of up to 65 wt% with simple dehydrators, resulting in great decreases in the amount of sludge. Since no coagulant is required during the process, additional water pollution problems are avoided. A density sensor is installed in the thickener to signal when the slurry should be drawn out by a pump to a storage tank. pH monitors are used during pH conditioning, and freez-thawing is controlled by brine temperature and a timer. A pilot plant has used the process with little trouble for over two years. The method is economically competitive with other dewatering techniques and reduces the mass of the dewatered cake to 1/2.5 of that of conventional methods. (Geiger-FRC)
W82-04599

APPLICATION EXAMPLES OF AND OPERATING EXPERIENCES WITH THE USE OF PROCESS COMPUTERS IN SEWAGE TREATMENT PLANTS,
Siemens A.G., Karlsruhe (Germany, F.R.).
E. F. Michel.
Water Science and Technology, Vol 13, No 10, p 483-488, 1981. 4 Fig, 5 Ref.

Descriptors: *Process control, *Computers, *Wastewater treatment, *Automation, Monitoring, Data processing, Wastewater facilities, Control systems, Operating costs, Electronic equipment, Maintenance costs, Netherlands, Sweden, Germany, Comparison studies.

The operating expeeriences of three sewage treatment plants, the Deventer facility (The Netherlands), the Malmo-Sjolunda plant (Sweden), and the Regenburg plant (Germany) are reviewed. The Deventer plant, which serves a population of roughly 120,000, is equipped with a SAMSY automated process control system. This system has been operating favorably since 1967 and has saved on energy costs, material, and personnel. The Swedish plant serves approximately 530,000 and features two central control stations. The entire process at the Malmo-Sjolunda plant is controlled and monitored by the SIMAT C/SAMSY automation system with the SIMATIC electronic control system as a backup for manual and remote controls. The Regensberg facility was designed to handle a population of 300,000 but plans to handle 400,000. This plant also uses the SIMAT C/SAMSY system along with free programmable electronic controls. These automated systems have improved process control, decreased power costs and reduced maintenance in the aforementioned plants. A new automation system concentrating on decentralized intelligence, the TELEPERM M, is also described. (Geiger-FRC)
W82-04600

EXPERIENCE WITH COMPUTER CONTROL OF WASTEWATER TREATMENT PROCESSES AT LOS ANGELES AND OTHER COMMUNITIES,
Los Angeles Bureau of Sanitation, CA.
W. F. Garber, and J. J. Anderson.
Water Science and Technology, Vol 13, No 11/12, p 759-770, 1981. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Computers, *Automation, Design criteria, Reviews, *Los Angeles, California, Municipal wastewater, Process control, Case studies.

Case study reviews were made of computer controlled wastewater treatment centers at the Hyperion treatment plant at Los Angeles, the Terminal Island treatment plant in Los Angeles, and the Glendale Water Reclamation Plant in Los Angeles, as well as treatment plants in Cleveland, Ohio; Bridgeport, Connecticut; Philadelphia, Pennsylvania; and Moorhead, Minnesota. The studies suggest that it is very difficult to provide isolated environmentally controlled spaces for computers in a wastewater treatment plant. Voltage or current variations lasting for microseconds could drastically affect the computer control systems when such systems were not isolated electrically from the power system supply lines. An analog control loop or other means of control should be provided for selected critical steps or processes, and these should be interfaced with the central processing computer. Computer control systems should not be designed as hybrid systems to handle process control and data processing. Conditions other than maximum should be considered during the design stage. The complexity of the computer control system and the frequency of measurement needs to be carefully studied prior to design. A prime manufacturer/installer should be selected who has the ability and desire to make an installed system work as designed. Cities and operating authorities must provide in advance the necessary trained and dedicated personnel. A number of large central process control computers are not meeting the reliability requirements needed for their acceptance as a useful tool for wastewater control. (Baker-FRC)
W82-04609

AUTOMATIC CONTROL OF SOLIDS RETENTION TIME AND DISSOLVED OXYGEN IN THE ACTIVATED SLUDGE PROCESS,
Environmental Protection Services, Burlington (Ontario). Wastewater Technology Centre.
J. P. Stephenson, B. A. Monaghan, and P. J. Laughton.
Water Science and Technology, Vol 13, No 11/12, p 751-758, 1981. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Automation, Computers, *Activated sludge process, *Dissolved oxygen, Monitoring, Solids, retention time.

This paper summarizes the dissolved oxygen (DO), solids retention time (SRT), and oxygen uptake rate (OUR) control approaches investigated at pilot scale. The pilot plant consisted of two identical parallel activated sludge units. The results indicate that a computer controlled facility can provide control of the instantaneous SRT equivalent to a well operated manually controlled plant. Energy savings and improved process operating conditions are achieveable through automatic dissolved oxygen control in activated sludge systems. The use of on-line process analyzers for flow and suspended solids, interfaced to a process computer, can provide effective solids inventory control in activated sludge systems. Automatic SRT control can provide solids inventory control equivalent to that achieved in a well controlled manually operated plant. No significant difference can be expected in the effluent quality based on effluent suspended solids. The use of OUR for control of plant solids inventory can be automated readily and merits further development and evaluation. (Baker-FRC)
W82-04610

WASTE WATER TREATMENT PLANT RELIABILITY - ENGINEERING DESIGN FOR FAILURE AND ECONOMIC GAIN,
UKAEA Systems Reliability Service, Warrington (England).
K. C. Hignett, and B. Sayers.
Water Science and Technology, Vol 13, No 11/12, p 743-750, 1981. 5 Fig.

Descriptors: *Mathematical models, *Wastewater treatment, Water treatment facilities, *Wastewater facilities, *Design criteria, Economic aspects, Engineering, Systems engineering, Case studies.

Quantified assessments of systems' availability may be derived on the basis of fault tree logic and mathematical modelling. The techniques described require a knowledge of representative failure data and downtimes. A data collection and availability modeling procedure were developed. A case study on sixteen wastewater plants was performed over a three year period, beginning in mid 1978. The study related to primary sedimentation systems, but the techniques are applicable to any system where basic failure data can be obtained. The analyses enabled weak areas in the systems to be identified and recommendations made for improving reliability. The results often confirmed the intuitive feelings of plant managers and made it possible to quantify the effects of different proposed improvements. The increased application of reliability technology can provide an important contribution to the realization of more efficient and lower cost waste water processing systems. (Baker-FRC)
W82-04611

ESTIMATION AND CONTROL PROBLEMS IN ACTIVATED SLUDGE PROCESSES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
S. Cook, and S. Marsili-Libelli.
Water Science and Technology, Vol 13, No 11/12, p 737-742, 1981. 2 Fig, 7 Ref.

Descriptors: *Activated sludge process, *Control systems, *Model studies, Mathematical studies, Wastewater treatment, Water quality, Monitoring.

This paper assesses the feasibility of some estimation and control schemes applied to the time varying operation of the Activated Sludge Treatment Process (ASTP). Real-time control of ASTP is becoming a significant issue in the context of water quality management. Preliminary results concerning the estimation of process variables are presented, and some new control concepts which imply the notions of optimality and energy conservation are introduced. Estimation and control algorithms developed are based on a reduced order model, thus making them easily implementable on microprocessors. Numerical simulation results are presented and discussed to assess the relative merits of the various algorithms. While far from exhaustive, this partitioned approach as demonstrated has shown the viability of Extended Kalman Filtering (EKF) state/parameter estimation and of optimal feedback control. Simulations have shown that improved performance and energy conservation can be achieved by using biochemical oxygen demand as a direct control variable. A foreseeable extension of the EKF properties concerns the inclusion in the performance index of some measure of upstream quality. In this way, the treatment cost can be made dependent of the present condition of the receiving water body. This, in addition to providing very sensible set points for diurnal operation, may help reduce treatment costs in many cases of medium or high flow conditions. (Baker-FRC)
W82-04612

PULSED-BED TECHNIQUE CAN CUT TREATMENT STAGES,
J. Irwin.
World Water, Vol 4, No 12, p 42-43, December, 1981. 1 Fig, 5 Tab.

Descriptors: *Percolating filters, *Backwash, Effluent, *Wastewater treatment, *Filtration, Sand filters, Filters, Separation techniques, Costs, Filter media, Clarification, Sludge treatment.

Pulsed-bed filtration is being used increasingly for primary effluent filtration (PEF) to reduce secondary treatment costs in municipal sewage plants as part of plant upgradings or expansions. Pulsed-bed units have a much shallower filter cell than conventional filters and can operate at heads of 0.6-1.5 m. They can accommodate high loading rates and cost less to backwash due to a special air diffuser device over the media surface. A pulse mix system helps fold the majority of particles into the media, while a screen media-retaining system permits filter media to be placed directly on top of the underdrain system for improved backwashing. A chemical detergent is used during backwashing, and a backwash control system recycles backwash water to a separate clarifier. The Hydro Clear Corporation has experimented with placing a pulsed-bed filter after the primary clarifier at several pilot plants. These efforts showed that primary clarification, PEF, and trickling filtered produced secondary quality effluent without final clarifiers at great cost reductions. Sludge treatment was also easier with PEF. Hydro Clear is developing a fine-sand pulsed-bed filtration technique for algae removal which may also be useful in potable water development and wastewater reuse. (Geiger-FRC)
W82-04613

DETOXIFICATION OF WASTE WATER CONTAINING CYANIDES FROM THE WET-SCRUBBING SYSTEMS OF STEEL MILLS (ENTGIFTUNG CYANIDHALTIGEN GICHTGASWASCHWASSER VON HOCHOFEN),
Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
B. Fischer, H. Ruffer, W. Duppers, G. Nagels, and H. Knorre.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 210-217, 1981. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Cyanide, *Steel industry, Effluents, Wastewater oxidation, Hydrogen peroxide, Formaldehyde, Catalysts, Weser River, Standards, *Germany.

Blast-furnace stack gas in steel mills is wet-scrubbed prior to utilization of its heat content. At the Bremen plant of the Klockner-Werke AG, process water is withdrawn from the Weser River; prior to return it must be treated to meet effluent standards, including a cyanide ceiling of 0.1 mg/liter. Various treatments for oxidative cyanide detoxification in scrubber water were considered: hypochlorite, ozone, catalytic oxidation with active carbon, peroxydisulfates, potassium permanganate, hydrogen peroxide, hydrogen peroxide/formaldehyde, and peroxymonosulfuric acid. Following laboratory trials, pilot tests were set up using the last four methods. The hydrogen peroxide-formaldehyde process was selected for full-scale trails. The initial settling basin was selected as the site for chemical introduction, since the turbulence of the inflowing stack gases provided adequate mixing. Sodium hydroxide was added to raise the pH of this water to 9-10. Chemical addition was metered via a sample stream. The goal of purifying the average flow of 1400 cu m per hour of wastewater at a maximum cyanide ion content of 50 mg/liter to register less than 0.1 mg/liter was attained during 93.5% of the measurement intervals in 6 months of operation. The standard for effluent from the settling basin, 1 mg/liter, was exceeded in 2.5% of the intervals, mostly for brief periods, due to operational problems. Chemical costs were about 2700 German Marks per day; the relatively high labor costs were primarily attributable to analytical requirements. The plant operated reliably even under the intensified demands caused by blast furnace shutdown. (Carroll-FRC)
W82-04616

DEMONSTRATION OF ZINC CYANIDE RECOVERY USING REVERSE OSMOSIS AND EVAPORATION,
Abcor, Inc., Wilmington, MA.
K. J. McNulty, and J. W. Kubarewicz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-231243, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency EPA-600/S2-81-132, September, 1981. 6 p, 3 Fig, 6 Ref. R805300.

Descriptors: *Metal-finishing wastes, *Reverse osmosis, *Evaporation, *Wastewater treatment, *Water reuse, Industrial wastewater, Zinc, Cyanide, Cost analysis, *Zinc cyanide recovery.

A field test was conducted to demonstrate closed-loop recovery of zinc cyanide rinse-water at a job shop plating facility. Since the zinc cyanide bath operates at room temperature with very little evaporation from the bath, reverse osmosis (RO) treatment of the rinsewater must be supplemented by evaporation in order to achieve the volume reduction necessary for return of a concentrate to the plating bath. The permeate from the RO unit was recycled to the first rinse after plating, while the distillate from the evaporator was recycled to the second rinse after plating. Spiral-wound PA-300 membrane modules were used in the RO unit. A gradual loss in membrane performance is attributable to fouling of the membrane by particulates in the rinsewater. Such fouling can be reduced by better prefiltration and reversed by periodic cleaning. The economics of the combined RO evaporation system were assessed for a system designed to provide rinsing equivalent to the present two-stage counter-current rinse at the demonstration site. The total operating cost was somewhat less for the combined RO evaporation system than for evaporation alone. However, credits for rinsewater recovery were insufficient to completely off-set the total operating cost of the recovery system. (Moore-SRC)
W82-04622

EVALUATION OF A TREATMENT LAGOON FOR COMBINED SEWER OVERFLOW,
Environmental Design and Planning, Inc., Boston, MA.
D. J. Connick, W. C. Pisano, and GL. Aronson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105214, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-196, December, 1981. 7 p, 6 Tab, 1 Ref. 11023FAV.

Descriptors: *Wastewater lagoons, *Combined sewer overflows, Disinfection, Stabilization lagoons, *Wastewater treatment, Industrial wastewater, Chlorination, Chlorine dioxide, Aerators, Oxygenation, *East Chicago, *Indiana.

The East Chicago Sanitary District operates a wastewater treatment plant that handles about 19 mgd of dry weather municipal wastewater from the city of East Chicago, Indiana. The sewerage system has combined sewers with overflows containing direct industrial discharges and runoff from industrial areas. The world's largest facultative lagoon was constructed tere to polish the secondary effluent from the wastewater treatment plant and to provide preliminary treatment with disinfection to the combined sewer overflows. Volume of the lagoon is estimated to be 142.2 million gal. Results of a two-year evaluation of the East Chicago lagoon indicate that relatively good treatment can be provided by a deep stabilization pond. During dry weather flow periods, the lagoon provided removal capabilities of 30 to 70% for the secondary effluent, depending on the parameter. The reoxygenation function of the aerators was found to be necessary. Under most circumstances, four aerators were adequate, but at times of high organic loading, the use of all eight appeared to be more advantageous. Disinfection results indicated that chlorination should be used until more reliable chlorine dioxide equipment is provided. The chlorine dioxide system should be reconstructed to provide extensive mixing upon initial disinfection, and it should provide a 15 to 30 second delay time between doses. (Moore-SRC)
W82-04623

PARALLEL EVALUATION OF AIR- AND OXYGEN-ACTIVATED SLUDGE,
Los Angeles County Sanitation Districts, Whittier, CA.
S. Austin, and D. Wuerdeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246712, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-155, September, 1981. 6 p, 5 Tab. 14-12-150.

Descriptors: *Activated sludge, *Wastewater treatment, *Secondary wastewater treatment, *Pilot plants, Aeration, Nitrification, Denitrification, Clarification, Trace metals, Organic compounds, Solids, Comparison studies, Carson, California.

To provide data on the relative merits of air and of oxygen in the activated sludge process, two 1,900 cu m/day activated sludge pilot plants were operated side-by-side at the Joint Water Pollution Control Plant, Carson, California. One incorporated the UNOX high-purity oxygen process, and one used an air-sparged mechanical aerator. Although both pilot plants met the applicable discharge limitations for everything but three trace metals, the oxygen system provided a more stable operation. The two systems obtained good removals of soluble organics, and factors affecting solids separation in the final clarifier are most significant in terms of their effects on effluent quality. The most notable detrimental factors encountered in the study were excessive input of aerator power, which sheared the flocs in both systems and nitrification-denitrification, which caused the settled sludge from the air system to resuspend. The oxygen system did not nitrify. Claims have been made that oxygen-activated sludge processes produce less sludge than air-activated sludge processes. In this study, the total plant solids were compared and the difference was found to be insignificant at the 90% confidence level. The results of power consumption estimates indicate that the oxygen systems use substantially less energy. (Moore-SRC)
W82-04624

TREATMENT EFFECTIVENESS: OIL TANKER BALLAST WATER FACILITY,

Rockwell International, Newbury Park, CA.
I. Lysyj.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-101361, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-192, October, 1981. 6 p, 3 Fig, 2 Tab. 68-03-2648.

Descriptors: *Ballast, *Oily water, *Oil tankers, *Wastewater treatment, Fjords, Trap zone, Stratification, Alaska, Hydrocarbons, Effluent, Organic compounds, Organic loading, Water pollution sources, Valdez, Alaska.

The large, modern ballast water treatment plant at the Valdez, Alaska, marine terminal was studied using specially developed chemical analytical methods to determine the effectiveness of each unit process and to characterize compositional changes in the process stream. The studies disclosed that the state-of-the-art processes are generally effective in reducing the free oil content of the oily wastewater discharged from arriving tankers. A reduction of more than 99.8% in the organic load of the process stream is realized with ballast water treatment by gravity separation, dissolved air flotation, and retention in polishing ponds. Less effectively removed, however, are the water soluble fractions of the oily wastewater, which often include five priority pollutants: benzene, toluene, ethylbenzene, phenol, and naphthalene. Such priority pollutants make up more than 50% of the total organic load in the effluent from the ballast treatment plant, and they are discharged in significant quantities into the receiving waters of Port Valdez. The plant discharges approximately half a metric ton of organic carbon each day. Included in this daily dischargew are 102 L of benzene, 91 L of toluene, 45 L of ethylbenzene/xylenes, 27 kg of phenol, and 2.8 kg of naphthalene. Because benzene, toluene, and ethylbenzene/xylenes constitute a significant fraction of the total organic discharge, their distribution in the receiving waters was studied. During the summer months, when the waters of the fjord are stratified, the effluent does not mix uniformly with the receiving waters, but forms a submerged field of diluted effluent. The aromatic hydrocarbons are contained at a depth of 50 to 70 m in a thin trap zone that spreads horizontally as far as 2 to 3 km from the plant outfall. The top of the trap zone moves progressively farther below the surface as the summer heating season progresses, from 50 m in June to 65 m in September. No aromatic hydrocarbons were found in the fjord outside the confines of the trap zone.
W82-04625

THE DEVELOPMENT OF DESIGN EQUATIONS FOR FACULTATIVE WASTE STABILIZATION PONDS IN SEMIARID AREAS,
J. P. Arthur.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 197-213, March, 1981. 13 Fig, 10 Tab, 14 Ref.

Descriptors: *Waste treatment, *Stabilization ponds, *Wastewater treatment, Temperature, Organic loading, Detention time, Bacteria, Sewage bacteria, Biological oxygen demand, *Nigeria, Semiarid lands, Ponds, Performance evaluation, Design criteria.

A comprehensive pilot scale study of waste stabilization ponds was conducted in semiarid northern Nigeria for a year. Two small ponds and 44-gal oil drums were arranged in various parallel and series combinations to investigate the effects of climatic factors and changes in organic loadings and detention times. The experimental systems provided excellent BOD and fecal bacteria removal. Anaerobic conditions occasionally developed as a result of overloading, but facultative operation became reestablished when favorable conditions returned. Temperature had a more significant effect on BOD and fecal bacteria removal than solar insolation. Equations were developed to aid in design of waste stabilization pond systems. Series ponds were more effective than single units. Other factors which promoted treatment efficiency were complete mixing, increased detention time, and optimum organic loading. (Cassar-FRC)
W82-04641

PILOT STUDIES OF THE NITRIFICATION PROCESS IN FIXED FILM REACTORS (PILOTVERSUCHE ZUR NITRIFIKATION IN FESTBETTREAKTOREN),
Hamburg Univ. (Germany, F.R.).
I. Sekoulov, and D. Heinrich.
Wasserwirtschaft, Vol 71, No 11, p 331-333, 1981. 4 Fig, 2 Tab, 3 Ref. English summary.

Descriptors: *Aerobic digestion, *Wastewater treatment, *Nitrification, Pilot plants, Fixed film reactors, *Germany.

The ability of nitrifying bacteria to grow attached to solid surfaces can be optimally utilized in fixed film reactors in order to concentrate them in a system. After the growth phase of the nitrifiers is complete, the hydraulic loading (residence time) is of practical importance for the nitrification behavior of the fixed bed reactor. Nitrifiers show ability to adapt to low oxygen concentrations and pH values, especially when they have been grown under these conditions. The nitrifiers produce very thin biological films which in themselves do not cause clogging of the reactors. However, when used in wastewater treatment the fixed bed reactors encounter suspended solids. In such cases it is necessary to provide the possibility for back-washing. The filler materials must permit uniform circulation. Expanded clay beads have proven to be acceptable filler materials. The proper size of a fixed-bed reactor can be selected with the aid of the Michaelis-Menten equation. Pilot-scale studies were conducted with two conventional fixed bed reactors, connected in parallel, and a completely immersed, rotating fixed bed reactor. In the case of non-limiting ammonium concentrations and short residence times, e.g., 0.5 hr, a maximal nitrification speed relative to the surface area of the filler material of 58.7 mg ammonium nitrogen per sq m per hr was achieved. If the nitrification rate is calculated relative to the reactor volume, the result is about 10 times higher than previously available values for activated sludge plants. (Carroll-FRC)
W82-04652

COMPARATIVE DISINFECTION OF POLIOVIRUS BY BROMINE CHLORIDE AND CHLORINE IN A MODEL CONTACT CHAMBER,
Hawaii Univ., Honolulu. Dept. of Tropical Medicine.
B. H. Keswick, R. S. Fujioka, N. C. Burbank, and P. C. Loh.
Water Research, Vol 16, No 1, p 89-94, January, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Disinfection, *Viruses, *Halogens, *Wastewater treatment, *Bromine chloride, *Chlorine, Chlorination, Poliovirus, Ammonium.

Bromine chloride proved superior to chlorine in inactivating poliovirus in 0.00009 M ammonium chloride solution and water containing 10% sewage effluent. In clear tap water both BrCl and Cl at doses of 0.5 and 2.0 mg per liter were effective disinfectants for poliovirus. The apparatus used for the studies was a 4 gal per min model contact chamber built to simulate conditions in a wastewater treatment plant. Concentrations of poliovirus in the initial mixture were 100,000 PFU per ml. The 2.0 mg per liter dose of BrCl was effective under all conditions. The 2.0 mg per liter dose of Cl failed to inactivate sufficient poliovirus when sewage effluent was present. (Cassar-FRC)
W82-04661

TEMPERATURE DEPENDENCY OF BIOLOGICAL DENITRIFICATION WITH ORGANIC MATERIALS ADDITION,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski.
Water Research, Vol 16, No 1, p 19-22, January, 1982. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Temperature, *Kinetics, *Denitrification, *Organic compounds, Biological treatment, *Wastewater treatment, Activated sludge process, Nitrogen removal, Methanol, Acetone, Acetic acid.

The rate of denitrification in a wastewater treatment process depends on temperature and on the compound used as the electron donor. Fresh activated sludge was incubated in laboratory plastic containers at eight temperatures from 2.5 to 35 C. Nitrate was added, followed by the organic compound, methanol, acetone, or acetic acid. Kinetic constants for the reactions are presented. Acetic acid was most effective in increasing the denitrification rate, acetone showed no improvement, and methanol was intermediate. The Arrhenius activation energy was similar in all cases, 10.9-12.3 kcal per mol. (Cassar-FRC)
W82-04662

TREATMENT OF NONCYANIDE ELECTROPLATING CADMIUM WASTEWATER BY REVERSE OSMOSIS,
Shanghai Inst. of Mechanical and Electrical Engineering (China).
F. Menwei, B. Tingyong, L. You, and Z. Aili.
Water Science and Technology, Vol 13, No 11-12, p 517-522, 1981. 3 Fig, 1 Tab.

Descriptors: *Cadmium, *Separation techniques, *Reverse osmosis, *Electroplating, *Wastewater treatment, Industrial wastes, Heavy metals, Membrane processes, Osmosis, Water pollution prevention, Chelating agents, Industrial wastewater.

Since cadmium (Cd) is hazardous to the environment and human health, the removal of Cd from the wastewaters of industries using Cd electroplating is an area of constant consideration. Reverse osmosis, a membrane separation technology, has been applied to noncyanide electroplating Cd rinse water. Closed-loop rinse systems using cellulose acetate membranes were tried in laboratory and pilot plant tests. The reverse osmosis units were of an out-press tubular structure and gave an average flux of 17 liters/sq m-h. At an operating pressure of 30 kilograms/sq cm Cd rejections of 95-98% were obtained. The reverse osmosis installation and its attachments require only 10 sq m of space and can restore 99% of the amount of Cd previously discharged. The present system when aided by some simple controllers was found to be suited for small-scale wastewater treatment operations. (Geiger-FRC)
W82-04664

ON LINE CONTROL OF PHARMACEUTICAL INFLUENT LOADS TO A BIOLOGICAL WASTEWATER TREATMENT PLANT,
OTV, Coubevoie (France).
A. Minier, H. Moreaud, G. Castelnau, and M. Mevolhon.
Water Science and Technology, Vol 13, No 11-12, p 523-529, 1981. 5 Fig.

Descriptors: *Biological wastewater treatment, *Flow regulators, *Activated sludge, *Respiration, *Wastewater treatment, Process control, Biodegradability, Fluctuations, Industrial wastes, Biological treatment, Pollution load, Control systems, *Pharmaceutical wastes.

A special pollution flux-regulator for the biological treatment of effluents in cases where the composition and flow rate are subject to considerable variation is described. The system is an industrial application of the metabolization technique in which wastewater is batch injected into a reactor containing activated sludge. A rapid respirometric test shows the affinity between the influent and the sludge bacteria and from this the biological reaction parameters are deduced. These parameters are then used to calculate the maximum load and hydraulic properties of the facility. This system has been successfully operated since July of 1980 for the treatment of wastes from the SAPCHIM pharmaceutical factory at Sisteron, France. An on-line biodegradability analyzer helps to regulate the flow between the storage tank and the contact tank of a biological treatment line by a contact-stabilization process. (Geiger-FRC)
W82-04665

OPTIMIZATION OF AREAWIDE WASTEWATER MANAGEMENT,

State Univ. of New York at Stony Brook. Inst. for Energy Research.
K. J. Phillips, E. J. Beltrami, T. O. Carroll, and S. R. Kellogg.
Journal Water Pollution Control Federation, Vol 54, No 1, p 87-93, January, 1982. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Wastewater management, *Planning, Design criteria, *Wastewater facilities, Wastewater treatment, Water treatment facilities, Computers, *Model studies, *Nassau County, New York.

This paper examines the application of a mixed integer programming screening model to determine a regional wastewater management plan of Nassau County, New York, in compliance with the federal '208' mandate. The model described in this paper was used to establish cost-optimal tradeoffs between the economies of scale from building larger treatment plants and the costs of piping to divert wastewater flows from the older systems. The model also defines in quantitative terms the price to be paid for increasing levels of treatment and improved water quality in Nassau County bays. The results suggest that mixed integer programming is a useful and flexible tool which enables the engineer to investigate a multitude of diversion, plant expansion, upgrading, and location alternatives and to develop an optimal plan for wastewater management within a region. The mixed integer program does not consume large amounts of computer time in its solution, as the preliminary engineering feasibility work reduced the number of options that had to be considered in the screening model. (Baker-FRC)
W82-04703

PHOSPHORUS REMOVAL PROCESSES FROM OVERLAND FLOW TREATMENT OF SIMULATED WASTEWATER,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. A. Khalid, W. H. Patrick, Jr., and M. N. Mixon.
Journal Water Pollution Control Federation, Vol 54, No 1, p 61-69, January, 1982. 5 Fig, 5 Tab, 32 Ref.

Descriptors: *Municipal wastewater, *Land disposal, Phosphorus, *Phosphorus removal, Wastewater treatment, Leaching, Isotherms, Sorption, Overland flow, Soil properties.

The effects of prereduced soil conditions and pH amendment with calcium carbonate on the efficiency of the soil/plant system for phosphorus removal in an overland flow model were determined. A relationship between phosphorus removal efficiency in an overland flow system and phosphorus sorption-desorption characteristics of the soil determined in the laboratory using phosphorus sorption isotherms was established. The overland flow experiments were conducted on a Crowley silt loam/ryegrass system established on a 1.2% slope and demonstrated that the efficiency of phosphorus removal from municipal wastewater would be greatly enhanced by the addition of lime to the soil. The phosphorus sorption isotherms indicated that the efficiency of phosphorus removal in the overland flow experiment was related to the phosphorus sorption capacity of various treatments. A slightly higher desorption of phosphorus sorbed by the soil mass in the limed treatments in the overland flow as well as in the laboratory studies was due to the lower phosphorus loading energy in this treatment. Phosphorus sorbed under alkaline conditions was more available to growing plants than the unamended treatments. The study also suggests that phosphorus sorption is a kinetic process and that the leaching losses of phosphorus retained by the soil mass during overland flow application would be smaller than the desorption potential determined under laboratory conditions because of longer contact time. (Baker-FRC)
W82-04706

INFLUENCE OF DISSOLVED OXYGEN ON SUBSTRATE UTILIZATION KINETICS OF ACTIVATED SLUDGE,
Kramer, Chin, and Mayo, Portland, OR.
M. K. Knudson, K. J. Williamson, and P. O. Nelson.
Journal Water Pollution Control Federation, Vol 54, No 1, p 52-60, January, 1982. 8 Fig, 1 Tab, 28 Ref.

Descriptors: *Activated sludge process, *Kinetics, *Wastewater treatment, Dissolved oxygen, Sludge, Bacteria.

The effect of mixed liquor dissolved oxygen (DO) concentrations on the maximum substrate utilization rate was evaluated and attempts were made to determine whether such effects correspond to changes in specific viability as well as to evaluate the influence of floc size on specific viability. Phenol was selected as the substrate due to its ease of measurement and low detection limit. It was concluded that the maximum substrate utilization rates of activated sludge based on total volume of suspended solids may increase with increasing DO concentrations over the range of 1.5 to 15 mg/l if flocs of greater than about 300 micrometers diameter are present. This effect can allow the operation of oxygen systems at higher specific utilization rates than air systems to obtain equal removals. Sludge production and effluent substrate concentrations may decrease with an increase in DO concentrations if flocs of greater than about 400 micrometers diameter are present. Maximum substrate utilization rates of activated sludge based on viable cells are constant with increasing DO concentrations over the range of 1.5 to 15 mg/liter. The maximum substrate utilization rates are directly related to the specific viabilities as measured by adenosine triphosphate content. A significant portion of activated sludge flocs may be DO limited at typical DO concentrations in some activated sludge plants. (Baker-FRC)
W82-04707

MUNICIPAL WASTEWATER RECLAMATION BY REVERSE OSMOSIS - A 3-YEAR CASE STUDY,
California Univ., Los Angeles.
M. K. Stenstrom, J. R. Davis, J. G. Lopez, and J. W. McCutchan.
Journal Water Pollution Control Federation, Vol 54, No 1, p 43-51, January, 1982. 4 Fig, 7 Tab, 21 Ref.

Descriptors: *Reverse osmosis, *Wastewater renovation, Membrane processes, *Wastewater treatment, Water demand, Water reuse, Municipal wastewater, *California.

An experimental and economic analysis of a 10 gallon/minute reverse osmosis (RO) pilot plant is presented. The study showed that flushes of citric acid, followed by enzyme detergent and spongeball cleaning, are effective in maintaining essentially the initial membrane-flux levels. Citric acid is the major cleaning agent. Enzyme detergent and spongeball cleaning without citric acid are relatively ineffective. The automatic spongeball cleaning technique appears to have promise for maintaining membrane flux between chemical cleanings. The major factor in determining membrane life for this type of membrane construction is corrosion, resulting in an average membrane life of 420 days or 10,000 hours. For the feed water investigated in this study, ferric chloride coagulation with clarification and filtration provided the highest quality feed water with the least fouling tendency. For the optimal conditions investigated, reclaimed water containing about 500 mg/l total dissolved solids can be produced for about 40 cents/cubic meter. The cost estimates are considered tentative. For all the conditions tested, the greatest level of pretreatment provided the most economical operation. The optimal energy requirements are about 2.6 K Wh/cubic meter. The relatively simple pretreatment used is stressed as a high point of this investigation. (Baker-FRC)
W82-04708

USE OF MICROSCREENS TO POLISH LAGOON EFFLUENTS,
Barber (B. P.) and Associates, Inc., Columbia, SC.
M. E. Harrelson, and J. B. Cravens.
Journal Water Pollution Control Federation, Vol 54, No 1, p 36-42, 1982. 7 Fig, 3 Tab, 8 Ref.

Descriptors: *Oxidation lagoons, *Algal control, Algae, *Lagoons, Oxidation, Wastewater treatment, Eutrophication, Algal growth, Screens, Filters, *Camden, South Carolina, *Water treatment facilities, Design criteria.

Pilot tests and design criteria employed in the construction of the Camden Wastewater Treatment Facility, South Carolina, are described. One of the main engineering concerns during the process selection procedure was the presence of alum-algae, which not only appear as suspended solids, but also exert an oxygen demand on the receiving stream from wastewater treatment plants. Bench tests were designed for microscreens at six lagoons in South Carolina. Tests indicated that the effluent values could be kept below 30/30 BOD5/SS. Algae counts and species identification were then performed in full-scale microscreen testing. To obtain design information needed, these pilot tests were performed at various drum speeds, backwash pressures, and head losses. Based on the test results, the preliminary cost analysis, and consultations, the decision was made to use the microscreens with ultrafine media for upgrading the oxidation ponds at the Camden site. The microscreens were made with 1 micron polyester media for low hydraulic loading. Standby equipment is provided for all major components. A high degree of operational flexibility was built into the design, and a fully automatic control and supervisory system is included to reduce the need for operator attention. During the past three years the process has been shown to be both a viable and an economical process. With efficient separation and recovery, the algae biomass could be used for energy production as well as for producing animal feed supplements or fertilizers. (Baker-FRC)
W82-04709

VACUUM FILTRATION OF SEPTAGE,
Lowell Univ., MA. Dept. of Civil Engineering.
C. R. Ott, and B. A. Segall.
Journal Water Pollution Control Federation, Vol 54, No 1, p 27-35, 1982. 2 Fig, 8 Tab, 7 Ref.

Descriptors: *Vacuum filtration, *Septic wastewater, Septic tanks, *Wastewater treatment, Filtration, Sludge, *Activated sludge process, Sludge thickening, Dewatering, Sludge drying, *Medfield, Massachusetts.

The feasibility of dewatering chemically treated septage by itself and in combination with thickened waste-activated sludge (TWAS) was explored at a municipal wastewater treatment plant in Medfield, Massachusetts. Chemicals used as septage conditioners were aluminum sulfate, ferric chloride, and sulfuric acid, each used separately. Conditioned sludges were dewatered on conventional coil-spring vacuum filters. In the majority of tests polymer was also used (Nalco 7120). The plant is a 0.066 cu m/sec conventional activated sludge process. During the septage dewatering study period the plant flow rate was 0.013 cu sec (0.3 mgd), and the primary clarifiers were not in use. The vacuum filter at Medfield is normally operated at about 55 kPa (8 psi) and at a rotational speed of 6.5 minutes per cycle. The cake yield during field test 1 averaged 12.1 kg/sq m/hr. The study showed that septage conditioned with either coagulant or acid could not be filtered unless combined with thickened waste-activated sludge. Reduction in cake yields observed during the course of 'septage only' runs was due to filter coil clogging with septage particles. Septage treated with sulfuric acid, ferric chloride or aluminum sulfate, combined in equal proportions with TWAS, vacuum-filtered well on a coil spring medium. Conditioned septage in combination with TWAS produced better yields than are normally experienced with TWAS alone. The best yields were obtained with aluminum sulfate conditioning and a 55% septage/45% TWAS mixture. Fe(III) and acid conditioning also produced excellent yields. (Baker-FRC)
W82-04710

AIR DRYING LIQUID ANAEROBICALLY DIGESTED SLUDGE IN EARTHEN DRYING BASINS,

Metropolitan Denver Sewage Disposal, District No. 1, CO.
J. C. Baxter, and W. J. Martin.
Journal Water Pollution Control Federation, Vol 54, No 1, p 16-26, January, 1982. 8 Fig, 7 Tab, 7 Ref.

Descriptors: *Sludge drying, *Wastewater treatment, Dewatering, Drying, Sludge, Sludge digestion, Groundwater, Water pollution sources, *Sludge utilization, Fertilizers.

The studies described were intended to examine the most efficient depths of sludge application that would enhance drying rates of sludge to the point where sludge could be handled as a solid (about 40% moisture) and then stockpiled for eventual use as a fertilizer. In conjunction with investigations of drying rates, the potential for groundwater degradation because of the leaching of nitrates from the sludge and possible methods for mitigating the amounts of potentially harmful pollutants were also investigated. Results of the study indicated that 25 cm applications of liquid sludge to earthen drying basins could lead to significant quantities of polluted water moving toward the groundwater. Data from 1977 studies indicate that any basin will leach significant quantities of polluted water if the sludge/soil interface is allowed to dry. Applications of 60 to 100 cm of liquid sludge led to a rapid sealing effect that produced an impermeable layer which prevented contaminants from moving toward the groundwater. Any operational scheme that removes sludge before the sludge/soil interface dries would preserve groundwater quality and at the same time provide a cost effective means of dewatering sludge. (Baker-FRC)
W82-04711

TREATMENT OF HIGH-STRENGTH FATTY AMINES WASTEWATER - A CASE HISTORY,
Huff and Huff, Inc., LaGrange, IL.
J. E. Huff, and C. B. Muchmore.
Journal Water Pollution Control Federation, Vol 54, No 1, p 94-102, January, 1982. 7 Fig, 8 Tab.

Descriptors: *Wastewater management, *Design criteria, Planning, Wastewater facilities, *Wastewater treatment, Biochemical oxygen demand, Aerated lagoons, Land disposal, Drainage, Tile drainage, *Fatty amines.

The waste treatment system originally designed for a new chemical complex which produces fatty amines is described. The system allowed for the collection of wastewater in containment basins, one located in each process area. In the event of heavy rainstorms, the basins overflow to a contaminated stormwater collection system. Each containment basin is pumped out to a separator and then to an equalization tank. The basic design concept was to minimize the formation of emulsions, which occur when the wastes from the various areas are mixed together. Wastewater from the equalization tank is pumped to an aerated lagoon. Wastewater from the second lagoon was originally designed to be pumped onto a 6.5 ha spray field, year around. A drain tile system was installed under the field due to poor drainage characteristics. The drain tile discharged into Aux Sable Creek via a man-made ditch. The major problem was the inability to achieve the Illinois effluent standard of 10 mg/liter for the 5-day biochemical oxygen demand (BOD). Based on treatability studies which were then made a land application system was selected for the expanded wastewater treatment facilities. Supplemental bacteria addition to the first stage lagoon was also evaluated, and has become an integral part of the overall system. The land application has demonstrated successful nitrification and denitrification. (Baker-FRC)
W82-04712

ANAEROBIC FERMENTATION - FILTRATION OF POTATO PROCESSING WASTEWATER,
AID Ltd., Fredericton (New Brunswick).
R. C. Landine, T. Viraraghavan, A. A. Cocci, G. J. Brown, and K-C. Lin.
Journal Water Pollution Control Federation, Vol 54, No 1, p 103-110, January, 1982. 8 Fig, 5 Tab, 9 Ref.

Descriptors: *Filtration, *Food-processing wastes, Industrial wastes, *Wastewater treatment, Food processing industry, Industrial plants, Fermentation, Anaerobic conditions, *Potatoes.

Experiments were conducted on a potato processing wastewater treatment system using a unified anaerobic fermenter-filter system. The mean chemical oxygen demand (COD) removal efficiency of the anaerobic fermenter on a clarifier waste with a high proportion of dissolved COD ranged from 73.3 to 86.8% when the loading rate was approximately 1 kg COD/cubic meter/day. The mean suspended solids (SS) removal efficiency through the anaerobic fermenter was inconsistent, as it was greatly influenced by SS concentration in the presettled feed. The effluent quality with respect to SS concentration was relatively consistent. The mean COD removal efficiency through the fermenter increased with loading rate, which implies that a higher optimum loading rate is possible. Mean COD and biochemical oxygen demand removal efficiencies through the fermenter did not change significantly when hydraulic detention time was lowered to 5 days from 10 with the loading rate maintained in the range of 1 kg COD/cubic meter/day, but both dropped about 10% between 5 and 4 days' detention. The mean COD removal efficiency through the anaerobic filter was 45.3 to 67.7% when the filter was loaded in the range of 0.82 to 1.20 kg COD/cubic meter/day and the hydraulic retention time was 8.2 to 19.2 hr. The COD removal in the filter decreased at the lower hydraulic detention times. The mean COD removal efficiency through the anaerobic fermenter-filter system was 85-95% when the fermenter was loaded at the rate of 1 kg COD/cubic meter/day. (Baker-FRC)
W82-04713

5E. Ultimate Disposal Of Wastes

LIME SOFTENING SLUDGE TREATMENT AND DISPOSAL.
Journal of the American Water Works Association, Vol 73, No 11, p 600-608, November, 1981. 6 Fig, 11 Tab, 32 Ref.

Descriptors: *Water softening, *Dewatering, *Lime, Reviews, *Sludge disposal, Calcium carbonate, Sludge volume index, Land application, Sludge lagoons, Lagoons, Sludge utilization, *Waste treatment, Drying, Cenirifugation, Filtration, Research priorities, Water treatment, Recalcination, Pelletization.

Recent advances in sludge handling and disposal are reviewed. Residues from lime softening are predominantly calcium carbonate and magnesium hydroxide, with small amounts of unreacted lime and residues from iron or aluminum coagulation. Sludge production can be minimized by removal of water, reduction of solids, or a combination of the two. Solids production can be reduced by using larger quantities of NaOH in place of some or all of the lime or soda ash, split treatment, optimization of chemical feed systems, sludge recirculation, reducing the degree of softening, recycling filter backwash, and controlling sludge withdrawals from the settling basin. Sludge treatment and disposal may use one or a combination of the following: gravity thickening, nonmechanical dewatering (lagoons and sand drying beds), mechanical dewatering (centrifugation, vacuum filtration, pressure filtration, and belt filtration), pelletization, recalcination, codisposal with other wastes, and land application. Results of survey replies from water softening plants are presented for subjects such as water source, chemicals used, calculated and reported sludge quantities, and dewatering methods. Lagooning is practiced at 56% of the plants; 13% discharge sludges into a river. Research needs include methods to increase solids contact to improve calcium carbonate precipitation, the role of calcium carbonate particle size, improvements in the pelletizing process, the fundamental process in mechanical dewatering, and long term effects of land application. (Cassar-FRC)
W82-04276

RECYCLING ALLOWS ZERO POWERPLANT WASTEWATER DISCHARGE,
For primary bibliographic entry see Field 5D.
W82-04323

SLUDGE DISPOSAL BY COMBUSTION OFFERS POTENTIAL ENERGY SOURCE,
Dorr-Oliver Inc., Stamford, CT.
J. H. Kleinau.
Pulp and Paper, Vol 55, No 13, p 141-143, December, 1981. 1 Fig, 6 Tab, 2 Ref.

Descriptors: *Sludge disposal, *Dewatering, *Incineration, Coal, Pulp and paper industry, Wastewater treatment, Energy sources, Filtration, Steam, Sludge cake, Fluidized beds.

Sludges high in organic materials, such as those from pulp and paper mills, can be economically dewatered, using pulverized coal as a filter aid and burning the resulting filter cake in a fluidized bed steam generator. Limestone added to the steam generator scavenges sulfur from the coal. A typical system uses 0.2 lb of coal along with each pound of sludge solids to produce a cake of 24% dry solids, suitable for incineration. Money saved by reduced sludge disposal and the value of steam generated (total $1.3 million) amounts to almost twice the annual operating costs ($765,000) in a 22,000 lb per hour plant. (Cassar-FRC)
W82-04329

SHAKING DOWN A SOLIDS HANDLING SYSTEM,
Greater Lawrence Sanitary District, North Andover, MA.
For primary bibliographic entry see Field 5D.
W82-04338

ANAEROBIC DIGESTION OF FARM WASTES: A REVIEW - PART 2,
Birmingham Univ. (England). Dept. of Chemical Engineering.
I. D. Cowley, and D. A. J. Wase.
Process Biochemistry, Vol 16, No 6, p 16-19, October/November, 1981. 2 Fig, 3 Tab, 35 Ref.

Descriptors: *Farm wastes, *Anaerobic digestion, *Methane, Wastewater treatment, *Waste disposal, Animal wastes, Reviews, Economic aspects, Safety, Manure, Digestion, Energy.

Processes for anaerobic digestion of farm wastes are reviewed. Typical instrumentation for a digester is described. Safety procedures involve isolation of motors in flameproof housings, prohibition of open flames on the site, use of a flare stack to burn off excess gas, and provision for proper relief valves. Digesters may be started up in two ways: (1) filling the digester with seed sludge, then slowly adding raw slurry, or (2) filling the digester 80% full of water and adding raw slurry and seed at the designed loading rate. Possible uses for the biogas are cooking, domestic heating, and electric power generation. Operating parameters are given for different types of digester systems and wastes. Heating and insulation are necessary to maintain the usual 30-35 C operating temperatures. Although biogas is not expected to make a major contribution to distribute gas supplies, it is economically sound to produce energy from material otherwise wasted. (Cassar-FRC)
W82-04347

WET DISPOSAL OF FOSSIL PLANT WASTE: CASE HISTORY,
Ebasco Services Inc., Norcross, GA.
K. A. Kessler.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 199-208, December, 1981. 10 Fig.

Descriptors: *Ponds, *Seepage control, Embankments, *Waste disposal, Powerplants, Ash, Clays,

Landfills, Slope stability, Soil properties, Soil mechanics, *Minnesota, Water pollution control, *Solid waste disposal, Dikes, *Clay Boswell Generating Station.

The planning, construction, and operation of a solid waste disposal pond for the Clay Boswell Generating Station, Minnesota, are described. This fossil fuel-burning plant is expected to produce 12.3 million cu m of solid waste (fly ash, bottom ash, and SO2 scrubber sludge) over its 35-year life. Wet ponding was chosen over two alternatives, chemical stabilization for landfill disposal and disposal in open pit iron mines. Boring tests located a suitable pond site with a continuous subsurface clay layer. The soils were further studied in the laboratory. The final design for the pond was an embankment built of random soil with a clay lining constructed on the upstream embankment slope. The entire pond was clay lined and soil-bentonite slurry cut-off trenches were installed down to the natural clay layer. Seepage calculations predicted a total long-term steady state seepage rate of 450 gal per acre per day. The pond, constructed during 1978 and 1979, consists of three compartments divided by earth dikes. Ash is kept covered with 2 ft of water. Piezometers, settlement mounments, and visual inspections are used for monitoring pond performance, which had met design expectations. A seepage problem in one compartment was the result of a frozen dividing dike. A reverse filter drainage system was constructed in the problem area to relieve the excessive piezometric head. (Cassar-FRC)
W82-04385

DENSITY LEVELS OF PATHOGENIC ORGANISMS IN MUNICIPAL WASTEWATER SLUDGE - A LITERATURE REVIEW,
Camp, Dresser, and McKee, Inc., Boston, MA.
D. C. Pederson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102286, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-170, October, 1981. 5 p, 2 Tab. 68-03-2803.

Descriptors: *Sludge drying, *Pathogens, *Disinfection, Parasites, *Viruses, *Bacteria, *Wastewater treatment, Literature review, Public health, Indicators, Lime, Anaerobic digestion, Composting, Aerobic digestion, Pathogenic fungi, Eggs, Sludge disposal.

Sludges originating from municipal wastewater treatment plants harbor a multitude of microorganisms, many of which present a potential health hazard. A literature review of available domestic and foreign data from 1940 to 1980 was undertaken concerning bacteria, viruses and parasites densities in raw municipal waatewater sludges, on the effectiveness of the 'Processes to Significantly Reduce Pathogens' (40 CFR Part 257), and on conventional sludge dewatering techniques to reduce levels of these organisms. Anaerobic digestion and lime stabilization consistently produce reductions of about 1 to 2 logs in densities of indicator and pathogenic bacteria, and in the case of anaerobic digestion, in densities of viruses as well. Conditions of mesophilic composting may inactivate common indicator and pathogenic bacteria and viruses, provided that specified temperatures are attained uniformly throughout the compost mass. The pathogenic fungus Aspergillus fumigatus thrives under conditions of mesophilic composting. Density reductions of bacteria by aerobic digestion are variable and of relatively small magnitudes. Sludge lagoons can achieve 1-log reductions in densities of bacteria and viable parasite ova, but storage of one month to more than three years may be required. Mechanical dewatering of sludge, with or without the use of chemical conditioners, has little reliable effect on densities of pathogens. (Moore-SRC)
W82-04400

DEEP WELL DISPOSAL OF SECONDARY EFFLUENT IN DADE COUNTY FLORIDA,
CH2M/Hill Inc., Gainesville, FL.
U. P. Singh, J. I. Garcia-Bengochea, and C. R. Sproul.
Water Resources Bulletin, Vol 16, No 6, p 812-817, October, 1980. 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Wastewater disposal, *Deep wells, *Transmissivity, Groundwater movement, *Injection wells, Underground waste disposal, Environmental effects, Groundwater management, Geophysics, Wastewater management, Subsurface drainage, Aquifer management, Aquifers, *Florida, Saline water intrusion, Dade County.

Drilling and testing were carried out on a test injection well site for deep underground injection of wastewater effluent from the proposed 50 mgd South District Regional Wastewater Treatment Plant of the Miami-Dade Water and Sewer Authority. The total depth of the well is 3,200 ft. The Boulder Zone, a highly cavernous and transmissive aquifer with water much like seawater, begins at 2,790 ft in depth. This zone is separated from the Floridan aquifer above it by about 1,100 ft of confining limestone layers. Packer testing proved these limestone layers very effective in separating the Boulder Zone, the proposed injection area, from the aquifer above. The transmissivity of the Boulder Zone was estimated at 14 million gallons/day/ft from pump-out test data. An 8,000 gallon/minute injection test was performed to evaluate well performance under operating conditions. A detailed monitoring program consisting of subsurface wells in various strata will be provided to monitor injection rate, injection pressure and effluent quality. A possible remedial action for salt water migration into the Floridan aquifer would be the construction of relief wells in the lower part of the aquifer. It was concluded that underground injection of secondary wastes from the proposed treatment facility is a feasible and cost-effective plan, both hydraulically and environmentally. (Geiger-FRC)
W82-04442

U.S. GEOLOGICAL SURVEY RESEARCH IN RADIOACTIVE WASTE DISPOSAL--FISCAL YEAR 1979,
Geological Survey, Reston, VA. Water Resources Div.
R. Schneider, E. H. Roseboom, Jr., J. B. Robertson, and P. R. Stevens.
Available from Br. of Distr., USGS 604 South Pickett St. Alexandria, VA 22304. Geological Survey Circular 847, 1982. 74 p, 15 Fig, 79 Ref.

Descriptors: *Radioactive waste disposal, *Geological surveys, *Waste storage, *Water pollution sources, Environmental effects, Waste management, Geology, Hydrology, Geochemistry.

The report summarizes progress on geologic and hydrologic research related to the disposal of radioactive wastes. The research is described according to whether it is related most directly to: (1) high-level and transuranic wastes; (2) low-level wastes, or (3) uranium mill tailings. Included is research applicable to the identification and geohydrologic characterization of waste-disposal sites, investigations of specific sites where wastes have been stored, and studies of regions or environments where waste-disposal sites might be located. A significant part of the activity is concerned with techniques and methods for characterizing disposal sites and studies of geologic and hydrologic processes related to the transport and(or) retention of waste radionuclides. (USGS)
W82-04500

AUTOMATIC CONTROL OF THE SEWAGE SLUDGE PYROLYSIS PROCESS IN MULTIPLE HEARTH FURNACE,
NGK Insulators, Ltd, Nagoya (Japan).
T. Kasakura, T. Majima, and N. Izumi.
Water Science and Technology, Vol 13, No 11-12, p 605-610, 1981. 3 Fig, 1 Tab.

Descriptors: *Incineration, *Sludge disposal, *Cost analysis, *Solid waste disposal, Automation, Control systems, Waste disposal, Sludge, Monitoring, Process control, Solid wastes.

An automatic control system for a 60 T/day sewage sludge pyrolysis plant with multiple hearth furnace has been developed as an energy-saving alternative to conventional incineration. The new control system maintains the required furnace temperature through control of the partial combustion ratio of the furnace by adjusting the amount of air supplied to the furnace. It also features stable automatic gas analysis and monitoring under severe conditions. A feed forward method is used to control the furnace and combustion chamber pressure, and the steam line of the waste heat boiler is designed so that some steam may be recycled other uses. These features result in a fuel comsumption one third that of conventional incineration methods. (Geiger-FRC)
W82-04587

AUTOMATIC CONTROL OF SLUDGE CONDITIONING AND VACUUM FILTRATION,
EMA, Inc., St. Paul, MN.
D. I. Knudsen, and G. A. Mathes.
Water Science and Technology, Vol 13, No 11/12, p 611-617, 1981. 6 Fig, 1 Tab.

Descriptors: *Sludge conditioning, *Vacuum filtration, Costs, Automation, Computers, *Activated sludge process, Sludge, Filtration, *Sludge disposal, Incineration, Process control.

This paper reports progressive development of control strategies and the resultant benefits derived from the Seneca Treatment Plant in Eagen, Minnesota. The plant is a 24 mgd activated sludge plant with two paralles 12 mgd trains. Two identical sludge processing trains consist of flotation thickeners, sludge holding tanks, chemical conditioning with ferric chloride and calcium hydroxide, vacuum filters, multiple hearth incinerator, and ash disposal by one common pipeline to a remote ash pond. The developmental nature of the project required a flexible control system. A microcomputer-based remote terminal unit communicates with a minicomputer over a four-wire asynchronous 1200 baud link. The minicomputer with its operations console is located in a buliding remote from the sludge disposal building. Various types of sludge conditioning and vacuum filter automatic process control resulted in economic benefits. The highest savings are achieved with a multivariable model based control strategy. Instrumentation requirements are met with proven equipment that does no require excessive maintenance. Properly applied sludge conditioning control strategies reduced ferric and lime usage, stabilized performance, increased production capacity, improved incinerator performance and decreased fuel usage. Operator and laborer requirements can be reduced because the control system can maintain continuity of stable operation with various sludge and chemical qualities. (Baker-FRC)
W82-04589

DENSIFICATION OF PAPER MILL SLUDGE MATERIALS,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
O. B. Andersland, A. W. N. Al-Khafaji, and R. K. Loew.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 1-15, January, 1982. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Dewatering, *Pulp and paper industry, *Compressibility, Sludge thickening, *Sludge disposal, Organic matter, Decomposition, Landfills, Void ratio, Waste disposal.

Densification of model paper mill sludges made from kaolinite and pulp fibers was studied to predict settlement of decomposing sludges. Densification involves removal of additional water from dewatered sludge, usually by placing surcharge loads in a landfill. Ignition tests were used to determine the organic content, and compression tests to follow the course of decomposition. The relationship between void ratio and organic fraction for a constant stress level was shown to be linear for the model sludges. A method was developed to calculate the void ratios as a function of pressure and organic content. These values agreed well with field data. Predictions of settlement of

decomposing sludges were formulated from the initial and final void ratios and the degree of decomposition. (Cassar-FRC)
W82-04694

APPLICATION OF THE WASTEWATER EFFLUENT OF A RURAL COMMUNITY TO A MOUNTAIN MEADOW,
Colorado E Agricultural Experiment Station, Fort Collins.
K. A. Barbarick, B. R. Sabey, and N. A. Evans.
Journal Water Pollution Control Federation, Vol 54, No 1, p 70-76, January, 1982. 7 Tab, 29 Ref.

Descriptors: *Land disposal, *Wastewater treatment, *Meadows, Effluents, Wastewater, Phosphorus, Sodium, Chlorides, Potassium, *Wastewater irrigation, Irrigation, Crop yield, Hay, Grasslands, *Impaired water use, Colorado, Hayden area.

Changes in the water, soil, and plant properties of a mountain meadow caused by sprinkler application of wastewater effluent or ditch water and the presence of subsurface drainage tiles or natural drainage were investigated. The study was conducted near Hayden, Colorado, at an elevation of 1977 meters, a latitude of about 41 degrees C, and a population of about 1,000. Ranching, farming and coal mining are the main industries of the area. A mountain meadow situated west of the Hayden wastewater treatment lagoons was used for the field study. The soil profile consists of layers ranging from a dark brown, silty clay loam to a mottled gray-brown clay. A gravel lens is encountered at depth of 1.5 to 2.0 meters. The meadow has been used for hay production for at least 10 years and has been flood irrigated continuously during this period. Application of effluent to the meadow produced only a few significant changes in area characteristics. Effluent caused significant increases in the chloride and sodium ion concentrations and uptake of sodium by plants in 1977. Hay yields, protein production and sodium and phosphorus uptake by plants were increased in 1978, and the concentrations of phosphate-phosphorus and exchangeable sodium and potassium in surface soil samples were also increased. Drainage tiles effectively lowered the water table for most of the 1977 irrigation season. The groundwater was below the drainage tiles in most of the 1978 season. Application of the effluent to the meadow for 2 years indicated that no environmental or health hazards resulted. (Baker-FRC)
W82-04705

5F. Water Treatment and Quality Alteration

THE SIDERITE MODEL OF THE FORMATION OF CORROSION-RESISTANT SCALES,
Karlsruhe University (Federal Republic of Germany), Water Chemistry Dept.
H. Sontheimer, W. Kolle, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 73, No 11, p 572-579, November, 1981. 11 Fig, 1 Tab, 36 Ref.

Descriptors: Corrosion inhibition, *Scaling, *Iron, Water distribution, Water mains, *Corrosion control, Water quality, Siderite, Ferrous carbonate, Calcium carbonate, *Pipes, Water supply systems, Protection, Chemical precipitation.

The concept that siderite ($FeCO_3$) is important in the formation of a protective, corrosion-inhibiting layer in water distribution pipes has led to a siderite model. The model is based on the following reactions: primary--formation of ferrous ion and 2 electrons from elemental iron, formation of hydroxyl ions from water, and formation of carbonates from bicarbonate; secondary--formation of calcium carbonate, ferrous carbonate, and goethite (FeOOH); tertiary--fromation of goethite pseudomorph and magnetite (Fe_3O_4) from ferrous carbonate. Laboratory studies were performed by measuring corrosion rates in steel pipe and by analyzing the chemical composition of the scale. Water from the Karlsruhe, Federal Republic of Germany, distribution system was used. Scales formed from highly buffered water contained 85-90% ferrous iron and 10-15% ferric iron. In slightly buffered water the ferrous portion was 40%. The more ferrous iron in the scale, the better the corrosion protection. The presence of humic acids, calcium ion, and lower oxygen concentrations all increased corrosion protection. although this simplified model cannot explain all observations, it may predict general trends. (Cassar-FRC)
W82-04270

SPECIFIC AND CHELATE EXCHANGERS: NEW FUNCTIONAL POLYMERS FOR WATER AND WASTEWATER TREATMENT,
Water Purification Associates, Cambridge, MA.
C. Calmon.
Journal of the American Water Works Association, Vol 73, No 12, p 652-656, December, 1981. 2 Fig, 7 Tab, 42 Ref.

Descriptors: *Ion exchange, *Chelation, *Metals, *Water treatment, *Wastewater treatment, *Polymers, Resins, Heavy metals, Anion exchange, Cation exchange, Bactericides.

The 1935 discovery of ion exchange resins has led to development of selective and specific ion exchange materials for water and wastewater treatments. This review presents the characteristics of 21 of these resins. The standard ion exchangers using sulfonic, carboxylic, or amine groups are not selective. All ions are packed up rather than the ones of concern, such as toxic metals. Regenerant costs are high, and selective recovery of ions from effluents is very difficult. Recently developed resins can remove specific metals, such as Hg or Cu, or groups of metals, such as the rare earths. A chelate resin, an insoluble polymer to which is attached a complexing group, involves both ion exchange and chemical reactions. Chelate resins have some limitations. Reaction rates are slower, special operating conditions during elution are required, and high concentrations of elutants may be needed. Recently bactericidal resins have been developed. These rely on (1) the affinity of amino and carboxylic groups in the organisms' tissues for the ion exchange resins, or (2) the presence of a bactericidal agent in the resin. (Cassar-FRC)
W82-04275

THE SEARCH FOR A CORROSION INDEX,
Environmental Science and Engineering, Inc., Gainesville, FL.
J. E. Singley.
Journal of the American Water Works Association, Vol 73, No 11, p 579-582, November, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Corrosion index, *Calcium carbonate, *Water quality, Alkalinity, Water distribution, Solubility, *Water mains, Hydrogen ion concentration, *Water supply systems.

A review of corrosion indexes revealed that no general corrosion index is available. It is not likely that a single index can apply to all metals. Some indexes have been applied in inappropriate circumstances. Use of any corrosion index should first be correlated with field test results to determine if it is applicable to a given water. Among the corrosion indexes described are: Langelier (1936), based on the effect of pH on the solubility of calcium carbonate, and a modification by Larson and Buswell (1942); Ryznar's (1944) stability index, with higher numbers indicating a more saturated water; Dye's (1958) momentary excess concept, the casil index, and the aggressive index which accounts for alkalinity. All these methods based on carbonate solubility equations are a measure of solubility of calcium carbonate, not corrosivity. Other methods are based on the ability of water to attack metal pipes and include additional factors. Parameters that must be considered in developing a corrosion index are hardness, alkalinity, carbonate, carbon dioxide, pH, chloride, sulfate, ionic strength, conductivity, total dissolved solids, color, hydrogen sulfide, buffer capacity, phosphate, silica, dissolved oxygen, chlorine, and temperature. (Cassar-FRC)
W82-04279

THE SCIENTIFIC BASIS FOR CONTROL OF LEAD IN DRINKING WATER BY WATER TREATMENT,
Wiggins Teape Research and Development, Ltd. (England).
I. Sheiham, and P. J. Jackson.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 6, p 491-515, December, 1981. 8 Fig, 8 Tab, 10 Ref.

Descriptors: *Drinking water, *Lead, Potable water, Heavy metals, *Water treatment, Alkalinity, Acidity, Carbonates, Water supply systems, Water quality.

Work is described which was carried out to identify the factors of water quality which determine lead concentration, to provide the ability to predict the types of water which give rise to excessive lead concentrations, and to define the methods and quality targets for water treatment to minimize lead levels in water. To achieve these objectives, the composition of deposits on the interior walls of lead pipes has been examined, the solubility of lead in water in equilibirum with these deposits has been calculated, and experimental tests have demonstrated the effects of a range of possible methods of water treatment to reduce lead concentrations. The study concludes that lead concentrations in water from lead pipes are limited to a high degree by the solubility of lead in water, and that water treatment can reduce lead levels effectively by ensuring that this solubility is as low as possible. In low alkalinity water, low pH is the predominant cause of high lead concentrations, and pH elevation to about pH 8.5 is required but not generally necessary to increase alkalinity. Addition of orthophosphate is a secondary approach to the treatment of this type of water. For water of high alkalinity addition of orthophosphate is the favored method of treatment, as simple pH adjustment is unlikely to produce a significant decrease in lead concentration. The large increase in pH required to produce substantial reductions in lead levels would have to be preceded by softening or removal of alkalinity, which are subjected to considerable disadvantages. (Baker-FRC)
W82-04301

REUSE OF BIOLOGICALLY TREATED WASTEWATER AS COOLING TOWER MAKEUP,
For primary bibliographic entry see Field 3C.
W82-04317

OBTAINING LAYOUT OF WATER DISTRIBUTION SYSTEMS,
Department of the Air Force, Washington, DC.
For primary bibliographic entry see Field 8A.
W82-04319

ZERO-DISCHARGE IN PRACTICE AT RAY D. NIXON POWER PLANT,
Ray D. Nixon Power Plant Water Supply, Colorado Springs, CO.
For primary bibliographic entry see Field 5D.
W82-04320

REGULATING CORROSIVE WATER,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6B.
W82-04335

HEALTH ASPECTS OF WATERS AT PUBLIC HEALTH RESORTS,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-04348

EXPERIMENTS IN IMPROVING RURAL WATER SUPPLIES,
Vermont Univ., Burlington. Dept. of Agricultural and Resource Economics.
F. O. Sargent, J. H. Mann, and T. N. Neiman.
Water Resources Bulletin, Vol 17, No 6, p 1008-1011, December, 1981. 1 Tab, 9 Ref.

Descriptors: *Information exchange, *Rural areas, *Water quality control, Public relations, Public participation, Public health, Attitudes, Surveys, Publications, Drinking water, *Water supply, Eutrophication, *Vermont, Local governments, Water treatment.

Two experiments in improving the information gap between rural Vermont water consumers and state agencies are described. Mann (1974) used an information display board, a survey of health officers, a health officers' conference, and a 3-month newspaper information compaign. Results indicated that people would take action to assure that their water supply passes minimum standards if they had proper information. A model news release was successful in reporting water quality problems to the public; it required only filling in blanks with the appropriate data. Meetings and training sessions for town health officers significantly reduced errors and problems in sampling water supplies. Neiman prepared two publications to help inform rural water users of water quality problems and solutions. 'A Handbook for Rural Water Users' explains the nature of drinking water standards, reasons for these standards, dangers and results of not meeting the standards, and cost effective alternatives for improving water quality. 'A Layman's Guide to Eutrophication' provides information on one of the subjects least understood by town officials. Obstacles to improvement of rural water supplies were lack of information exchange between local officials and consumers, fragmentation of agencies into diverse departments, and public apathy. (Cassar-FRC)
W82-04350

WHEN A WATER SUPPLY WENT BAD.
For primary bibliographic entry see Field 5C.
W82-04357

CONSIDERATIONS ON ORGANIC MATTER IN DRINKING WATER TREATMENT,
Municipal Water Works of Rotterdam (Netherlands).
J. J. Rook, A. Graveland, and L. J. Schultink.
Water Research, Vol 16, No 1, p 113-122, January, 1982, 6 Fig, 5 Tab, 3 Ref.

Descriptors: *Organic matter, *Chlorinated hydrocarbons, *Activated carbon, *Water treatment, Drinking water, Design criteria, Surface water, *Netherlands, Performance evaluation, Organic carbon, Water quality, Ozonation, Chlorination, Adsorption, Water treatment facilities.

The efficiency of organic matter removal was evaluated in four water treatment systems in the Netherlands. All systems used stored surface water as the raw water source. Performance varied according to the parameters chosen. Most groups of parameters gave incomplete information. The classic parameters, COD, permanganate, ultraviolet extinction, and color, may give false impressions of removal efficiencies when oxidative treatments are involved. The instrumental total organic carbon (TOC) method is the most reliable in this group. The parameters, taste, color, and odor, also give limited information on water quality. A method for determining biodegradable organic matter (AOC) introduced by van der Kooy (1978) is the best parameter to judge efficiencies of water treatment chains from the bacteriological aspect. Toxic material parameters include chlorinated organic compounds and organically bound chlorinated compounds adsorbable on activated carbon (AOCl). In designing drinking water treatment trains, water should have minimum: (1) taste and odor, determined by organoleptic means, (2) toxic substances, determined by halogenated organic compounds (AOCl), and (3) bacterial count, determined by the AOC test and 22 C bacterial counts. This procedure helps avoid overtreatment. Parameters (bacterial counts, AOC, trihalomethanes, and AOCl) are given for the four treatment systems: (1) prechlorination plus granular activated carbon, Rhine River and polder water, (2) prechlorination and powdered activated carbon, Meuse River, (3) ozonation and biological filtration, highly colored water, and (4) ozonation and granular activated carbon, Meuse River, (Cassar-FRC)
W82-04374

LEAK DETECTION PROGRAMS RECOVER REVENUES,
Community Consultants, Inc., Provo, UT.
For primary bibliographic entry see Field 3D.
W82-04375

GRANULAR ACTIVATED CARBON INSTALLATIONS,
Culp/Wesner/Culp, Cameron Park, CA.
R. L. Culp, and R. M. Clark.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102492, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-177, October, 1981. 9 p, 1 Fig, 1 Tab.

Descriptors: *Activated carbon, *Water treatment, *Cost analysis, *Drinking water, *Adsorbents, Wastewater treatment, Reactivation, Odor control, Color removal, Organic compounds.

On January 9, 1978, EPA proposed the use of granular activated carbon (GAC) as a means of treating drinking water. Questions have been raised regarding EPA's cost estimates for GAC use. As part of studies designed to establish water supply unit process costs, GAC treatment design criteria, performance, and cost data were compiled from 22 operating municipal and industrial GAC installations that treat water and wastewater, and that process food and beverage products. Results indicate that a substantial number of GAC installations have been operating successfully for many years. Although long-term use of GAC and powdered activated carbon by municipal waterworks and industries has been widespread, no adverse health effects have been reported. GAC treatment of public water supplies to remove trace organics is fairly new, but GAC treatment of public water supplies for taste and color control or for color removal is practiced in about 46 cities in the US. Pilot plant testing of GAC adsorptive and reactivation characteristics in municipal water treatment plants can be combined properly with the known costs of GAC systems in wastewater treatment to yield a design basis and preliminary cost estimates that are satisfactory for developing water treatment projects. (Moore-SRC)
W82-04391

EFFECT OF HALOGENS ON GIARDIA CYST VIABILITY,
Oregon Univ. Health Sciences Center, Portland.
E. A. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102294, Price codes: A02 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-174, October, 1981. 3 p, 2 Ref. R-806032.

Descriptors: *Giardia, *Disinfection, *Drinking water, *Water treatment, *Chlorination, *Iodine, Water temperature, Hydrogen ion concentration, Protozoa, Parasites, Halogens.

The vehicle for spreading epidemic giardiasis is drinking water. The development of a method to induce the excystation of Giardia cysts has made possible, for the first time, a reliable method of determining Giardia cyst viability, and thus, the ability to determine whether a given procedure kills these cysts. Using this method, the effects of halogens on thee cysts of G. lamblia were tested. In one set of experiments, chlorine was tested under a variety of conditions including chlorine concentrations, temperature, pH, and chlorine-cyst contact time. Within the range of variables studied, the ability of cysts to excyst after treatment was affected by each of these variables. Percent excystation decreased with: increasing chlorine concentration; increasing temperature; decreasing pH; and increasing contact time. In a second set of experiments, six small-quantity water disinfection methods were tested. Two methods (Halazone and bleach) employed a form of chlorine, and four methods (Globaline, EDWGT, and elemental iodine in tincture and in saturated form) involved some form of iodine. Halazone and EDWGT inactivated all of the cysts under all test conditions. Bleach, Globaline, and tincture of iodine only failed to inactivate all cysts under one set of conditions: in clear water at 3 C. Saturated iodine failed to inactivate all of the cysts in either clear or cloudy water at 3 C, but inactivated all cysts at 20 C. (Moore-SRC)
W82-04401

THE IDENTIFICATION AND TREATMENT OF BROMIDES AND TRIHALOMETHANES IN POTABLE WATER FROM THE PEARL RIVER AT JACKSON, MS: EVALUATION OF TOXICITY ON SPECIES DIVERSITY,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 5A.
W82-04413

COAGULATION MECHANISMS: AN ELECTRON MICROSCOPIC STUDY USING ALUMINUM SULFATE,
Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
T. Ishibashi.
Journal of the American Water Works Association, Vol 72, No 9, p 514-518, 1980. 8 Fig, 9 Ref.

Descriptors: *Turbidity, *Water treatment, Drinking water, Potable water, *Coagulation, Clays, *Aluminum sulfate, Zeta potential.

A transmission electron microscopic study was performed to obtain visual data on the mechanism of coagulation. The findings call into question the validity of the double-layer theory of coagulation on clay colloid. Shokozan clay, classified mineralogically as dickite clay, was selected for the study. After the clay solution settled for 24hr, microscopic inspection revealed particles several micrometers in diameter among the particles remaining in suspension. Further treatment of the suspension was rendered. The primary stage of coagulation of the clay colloid was reached by adsorption of soluble aluminum hydrolysis ions and by the chemical reactions producing aluminum hydroxide on the surface of the clay particles. The coagulation could be carried out at a zeta potential of -26.6 mV, much lower than the typical values reported in the literature, suggesting that coagulation was not directly related to the zeta potential value. At this low dosage of alum the coagulated particles and the uncoagulated particles coexisted in the suspension. Adsorption and chemical reactions between soluble aluminum hydrolysis ions and the surface of clay particles seem to be completed instantaneously after the alum dosing. Whether aluminum hydroxide is formed in films on the colloids or on independent particles may have a significant effect on the floc growth. The double-layer theory holds that the zeta potential and the colloid stability are correlated, and that a sufficient reduction of zeta potential is needed to achieve coagulation. In this study coagulation was carried out even with high zeta potential, indicating that adsorption of potential determining ions and bridging explain the observed phenomena better than the double-layer theory. (Baker-FRC)
W82-04423

COAGULATION: EXPERIENCES IN ORGANICS REMOVAL,
Minnesota Univ., Minneaplis. Dept. of Civil and Mineral Engineering.
M. J. Semmens, and T. K. Field.
Journal of the American Water Works Association, Vol 72, No 8, p 476-483, August, 1980. 17 Fig, 1 Tab, 10 Ref.

Descriptors: *Water treatment, *Coagulation, Organic compounds, Trihalomethanes, Sludge, Alum, Acidity, Temperature effects, Flocculation, Sampling, *Mississippi River, *Minneapolis, Minnesota.

Coagulation tests were run of water samples taken from the Mississippi River close to the point of extraction for the Minneapolis water treatment plant. The water is high in organic content, with dissolved organic carbon concentrations ranging between 10 and 16 mg/liter during the course of the study. Turbidity ranged between 2 and 25

NTU. The coagulation process with alum as the sole coagulant was found to be capable of achieving significant organics removal from the Mississippi River water. The removals were found to be strongly pH and dose dependent. Organics absorbing ultraviolet light are removed more effectively by coagulation. Tests conducted on unconcentrated and reconstituted Mississippi River water at various times indicate that the organics removal was very reproducible. The only significant variation was noted when low alum doses were used in high turbidity waters. The influence of varying flocculation times on turbidity and organics removal was examined for three river water samples. Tests were also conducted to determine whether the organics removal performance could be improved by altering the way in which the coagulant was added to the river water. The results essentially indicated that there was no benefit to a two-stage coagulation process. Similar results were obtained with the three- and four-stage studies. The recycling of sludge to supplement an alum dose did not improve organics removal compared to controls receiving no recycled alum sludge. It was concluded that the most important variables influencing organics removal by alum coagulation are alum dose and pH. (Baker-FRC)
W82-04424

CONTROL OF TRIHALOMETHANES IN DRINKING WATER,
Louisville Water Co., KY.
D. T. Duke, J. W. Siria, B. D. Burton, and D. W. Amundsen.
Journal of the American Water Works Association, Vol 72, No 8, p 470-476, August, 1980. 5 Fig, 5 Tab.

Descriptors: *Drinking water, *Organic compounds, Water quality, *Water treatment, Potable water, *Trihalomethanes, Activated carbon, Hydrogen peroxide, Chlorination, Ammonification, Ammonium.

The implementation of effective methods for the control of trihalomethanes (THM) is neither impossible nor overly difficult. Methods such as ammoniation for hindering THM increases after chlorination have been explored and the technology is available, as is the technology for other methods of disinfecting water supplies without forming significant amounts of THMs. While these do pose an inevitable cost problem, they also present solutions to the major problem. Each plant must survey its individual needs for THM control and select the most appropriate technology for the job. One test that has been widely used to study the effect of chlorination on source waters is the trihalomethane formation potential test (THMFP). Temperature, pH, chlorine dosage and chlorine contact time are the critical factors in this test. Since chlorine contact time is critical in THM formation, a system that reduces this contact time may feasibly reduce THM formation. The THMFP of the source water increases as the temperature of the water increases, peaking during the summer months. Use of ammoniation in place of chlorination offers an effective means of reducing THM growth. The use of chloramines, ozone, and hydrogen peroxide as disinfectants that do not form THMs should also be considered. Hydrogen peroxide, a dechlorinating agent, when used in conjunction with chlorine might provide the right combination to achieve complete disinfection and prevent THM formation simultaneously. The cost of chemicals for this treatment would be significantly higher than for ammoniation, but the results are much more successful. Suggested use of granular activated carbon pertains to a wider scale removal of organic compounds than just THMs. (Baker-FRC)
W82-04425

THE MONOCHLORAMINE-GAC REACTION IN ADSORPTION SYSTEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Environmental Engineering.
B. R. Kim, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 72, No 8, p 488-490, August, 1980. 3 Fig, 11 Ref.

Descriptors: *Adsorption, *Activated carbon, Granular activated carbon, Simulation, Model studies, Water treatment, Drinking water, Potable water, *Chlorination, Organic compounds, *Monochloramine, Chemical reactions.

This paper deals with the reaction kinetics of monochloramine, a critical component of chlorine residual, with granular activated carbon. The results show the effect of influent concentration, flow rate, contact time, and carbon particle size on the GAC-ammonium chloride reaction. Monochloramine reacted slowly with GAC by comparison to the rates at which free chlorine and dichloramine react. After an acclimation period, the effluent ammonium chloride concentration from a GAC contactor reaches a steady state value if such influent conditions as ammonium chloride concentration, flow rate and other factors do not change. The reaction rate at steady state is slower than the initial rate. At steady state the reaction rate for ammonium chloride is very slow if the solution concentration is below about 1 mg/liter as chlorine. Very long contact times are therefore required if the concentration is to be reduced below detectable levels. (Baker-FRC)
W82-04426

EVALUATION AND TREATMENT OF SYNTHETIC ORGANICS IN DRINKING WATER SUPPLIES,
Montgomery (James M.), Pasadena, CA.
R. R. Trussell, and A. R. Trussell.
Journal of the American Water Works Association, Vol 72, No 8, p 458-470, August, 1980. 21 Fig, 5 Tab, 51 Ref.

Descriptors: *Water supply, *Organic compounds, Pollutant identification, *Drinking water, Potable water, *Water treatment, Reulations, Evaluation, Reviews, *Synthetic organics.

An approach is outlined which a water utility might employ to evaluate the purity of its water source, review the effectiveness of its current treatment, assess the exposure of the consumer to risks, study the feasibility of various courses of action, and implement a final plan. The task of dealing with synthetic organics can be divided into six parts: source evaluation, risk assessment, feasibility analysis, scheduled periodic surveillance, cost-benefit analysis, and implementation. Tasks required to evaluate the integrity of the quality of a water source are the source survey and the source analysis. Once source evaluation is complete, an assessment must be made of the health risk imposed on the population consuming the water. Potential synergistic and antagonistic effects must be considered between different compounds. If the results of the source evaluation and risk assessment are not satisfactory, a feasibility study must be conducted to determine the most effective means of providing a safe water supply. Five basic alternatives may be considered if the water supply is not adequately protected: find a protected source; eliminate the contaminants; use a combination of off-line storage with river supplies so that water can be drawn off during periods of good quality; treat the water supply to remove the materials of concern; and install dual distribution systems and use water from a protected source for domestic supply and water from the unprotected source for less exacting uses. Treatment may include aeration, coagulation, oxidation, biological processes and adsorption. (Baker-FRC)
W82-04427

REMOVAL OF TOTAL ORGANIC HALOGEN BY GRANULAR ACTIVATED CARBON ADSORBERS,
Illinois Univ. at Urbana. Champaign. Dept. of Civil Engineering.
J. E. Quinn, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 72, No 8, p 483-488, August, 1980. 14 Fig, 3 Tab, 6 Ref.

Descriptors: Water quality, *Organic carbon, Adsorption, *Activated carbon, *Halogens, Hazardous materials, *Water treatment, *Monitoring, Drinking water, Potable water, Water supplies.

This study was undertaken to show the potential for using total organic halogen (TOX) measurements to determine the degree of saturation of activated carbon adsorbers. Humic substances, a major constituent of natural waters, were chlorinated and applied to laboratory columns for this purpose. Samples taken at several times from experimental adsorbers at Jefferson Parish, Louisiana, were also evaluated. The results of the study showed that for these adsorbates TOX buildup on the carbon was gradual and consistent, and that measurement of the TOX profile in the adsorber at different times can be used to determine when the adsorption capacity has been depleted and replacement or regeneration is needed. Determination of the TOX profiles at Jefferson Parish showed a gradual saturation of adsorption capacity at all depths with time. Thus it appears that measuring the group parameter total organic halogen may be an acceptable alternative to analyzing specific compounds in order to monitor water quality and the efficiency of water treatment processes for removing potentially hazardous organics. (Baker-FRC)
W82-04429

EFFECTS OF CHLORINE CONCENTRATION ON THE STRUCTURE OF POLIOVIRUS,
New Mexico State Univ., Las Cruces. Dept. of Biology.
M. E. Alvarez, and R. T. O'Brien.
Applied and Environmental Microbiology, Vol 43, No 1, p 237-239, 1982. 1 Fig, 4 Ref. OWRT-A-066-NM.

Descriptors: *Viruses, *Chlorination, Wastewater treatment, *Water treatment, Chemical reactions, Poliovirus.

Relationships are explored between chlorine concentration, loss of viral infectivity and viral composition in aqueous medium changes. Poliovirus type 1 (Mahoney) was used in the study. At chlorine concentrations up to 0.4 mg/liter, there were no major changes in the poliovirus sedimentation coefficients, although virus inactivation was 38%. At chlorine concentrations of 0.8 mg/liter or higher, there was a shift of the virus sedimentation coefficients from the 156S value associated with intact particles to 80S, which was shown to represent structures lacking RNA. The percentage of counts associated with empty capsid peaks did not correlate with percent inactivation values. These results indicate that changes in virus composition and structure are dependent on the initial chlorine concentration and that these changes are not the primary cause of virus inactivation. Chlorine concentrations in excess of 0.8 mg/liter apparently lead to reactions within the virus particles which can result in separation of the viral components. (Baker-FRC)
W82-04525

WATER IN PHARMACEUTICALS AND COSMETICS INDUSTRIES,
Chiltern Water Treatment Co. (England).
R. W. Hill.
Effluent and Water Treatment Journal, Vol 21, No 11, p 515-517, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Water quality, *Industrial water, *Water treatment, Reverse osmosis, Filtration, Membrane processes, Standards, Bacteria, Water use, *Pharmaceutical industry, *Cosmetic industry.

The treatment of water which appears in the products of the cosmetics or pharmaceuticals industries is discussed. In the British Pharmacopoeia two categories are specified for water used by the pharmaceutical industry, purified water and water for injections. The major difference between these two categories is that purified water refers to chemical impurities, while water for injection must also be free of biological contaminants. With the exception of injection and infusion solutions, other products will be exposed at some time to the atmosphere and thus to possible biological contamination. It is usually necessary to use purified water even for apparently non-critical cosmetics because contaminants may interfere with the manufacturing process or cause deterioration in the

appearance of the product. Ion exchange is fast becoming the most common method of preparing purified water on the commercial scale. Reverse osmosis is able to remove non-ionized contaminants and is becoming increasingly popular. However, this method alone will not usually effect sufficient removal to meet purified water requirements, and it is usual to employ a mixed bed ion exchange polishing unit downstream. Reverse osmosis can be used for producing sterile water, but there is some recent evidence that certain small bacteria, viruses and pyrogens can pass through the semipermeable membranes. Storage of high purity water is difficult, as this substance is an exceptionally good solvent. Care must be taken in selecting construction materials for purified water systems. Polishing filters should be employed at the points of use whenever possible. (Baker-FRC)
W82-04533

THE NECKAR AS A SOURCE OF PROCESS AND RESERVE WATER (DER NECKAR ALS LIFEFERANT VON BETRIEBS- UND RESERVEWASSER),
Technisch Werke der Stadt Stuttgart (Germany, F.R.).
K. E. Oehler.
GWF-Wasser/Abwasser, Vol 122, No 12, p 566-571, 1981. 2 Fig, 5 Tab. English Summary.

Descriptors: *Water supply, *River water, *Municipal water, Water quality, Neckar River, *Stuttgart, Germany, Impaired water use, Ammonium, Process water, Industrial water, Water distribution, *Water treatment, Potable water, Drinking water, Chlorination.

Following completion of the Lake Constance drinking water supply for the city of Stuttgart, the Berg water treatment plant on the Neckar River was kept in operation to supply industrial process water, to serve as an emergency supply for the city if needed, and to reduce the demand on the piped supply. Berg water is used in a power plant, the gas plant, the city laundry, the railway, the parks and fountains of the city, and municipal air conditioning facilities. The quality of Neckar water is still monitored regularly. The principal problem pollutants in the Neckar at present are high ammonium concentrations and trihalomethanes. Detailed analyses of chemical composition for 1980 revealed significant changes only during extremely high and low flow. During high flow sludge transport was noted, and enrichment of wastewater constituents occurred during low flow. Nevertheless most water quality parameters still fell within the highest quality class, except for phosphate and ammonium concentrations. The water treatment of the Neckar supply comprises sub-breakpoint chlorination, aluminum sulfate flocculation, settling and rapid filtration. Powdered activated carbon, slow sand filtration and charcoal filtration are used only in the case of drinking water. Low-level chlorination is the final step. This simplified treatment and the short distribution pathways make it possible to supply the process water at half the cost of normal drinking water. (Carroll-FRC)
W82-04546

TREATING TASTE AND ODOUR PROBLEMS USING OZONE AND ACTIVATED CARBON,
Degremont Infilco Ltd., Rueil-Malmaison (France).
R. Cyr, and Y. Richard.
Water and Pollution Control, Vol 119, No 12, p 15-17, December, 1981.

Descriptors: *Ozone, *Activated carbon, *Taste, *Odor control, Water treatment, Adsorption, Filtration, Clarification, Organic matter, Monsang-sur-Seine, France, *Paris.

The 13.9 mgd Monsang-sur-Seine plant suplying water to Paris suburbs has incorporated granular or powdered activated carbon and ozone into the treatment process. The ozone treatment step takes place between the clarification-sand filtration step and the activated carbon treatment. This sequence eliminates taste and odor in the water prolongs the useful life of the carbon. This procedure produces good quality water in spite of the variable quality of the raw river water, which is occasionally polluted, especially during low flow in summer. (Cassar-FRC)
W82-04553

PURIFICATION OF SURFACE WATERS (REINIGUNG VON OBERFLACHENWASSER),
Boliden-Knapsack G.m.b.H., Hurth-Knapsack (Germany, F.R.).
G. K. Kohler.
Wasser, Luft und Betrieb, Vol 25, No 11, p 10-12, 1981. (No English Summary).

Descriptors: *Water treatment, *Drinking water, *Filtration, Flocculation, Chemical coagulants, Flotation, Separation techniques, Magnetic separation, Phosphate removal, Surface water, Tegeler Sea, *Berlin, Germany.

Increasing demands for water necessitate the use of increasing amounts of surface water for drinking water preparation. Numerous studies have been conducted on improved methods for surface water treatment, including especially flocculation. Phosphorus removal is a major goal of flocculation and of combined chemical precipitation and filtration. The use of a two-filter system with a second flocculation step between the filters greatly improves phosphate removals. Including a container flocculation step before the filter increases filter life and phosphate retention without excessive chemical addition. This system was applied to cleanup of water obtained from the heavily contaminated Tegeler Sea near Berlin. Sludge retention was a substantial problem during the trial runs. Tube flocculation could markedly increase floc removal efficiency. Magnetic flocculation is another possibility for increasing flocculation efficiency. Flotation may be preferable to flocculation in special circumstances. Nevertheless available systems are not yet perfect in efficiency. (Carroll-FRC)
W82-04577

SELECTIVE REMOVAL OF FLUORIDE, ARSENATE AND PHOSPHATE IONS FROM WATER (SELEKTIVE ENTFERNUNG VON FLUORID-, ARSENAT- UND PHOSPHATIONEN AUS WASSER),
Institut Fresenius, Chemische und Biologische Laboratorien GmbH, Taunusstein-Neuhof (Germany, F.R.).
W. Fresenius, and W. Schneider.
Wasser Luft und Betrieb, Vol 25, No 11, p 14-15, 1981. 12 Ref. (No English Summary).

Descriptors: *Water treatment, *Fluoride, *Adsorption, Aluminum oxide, Arsenic compounds, *Phosphate removal, Drinking water, Hydrogen ion concentration, Aluminum compounds.

Available waters in some localities exceed the maximum permissible levels for fluoride, phosphate and arsenate, and therefore require treatment prior to consumption as drinking water. Special grades of aluminum oxide were developed as fluoride adsorbents and tested in a pilot scale installation. Residual fluoride contents below 1 mg/1 were obtained using initial waters with fluoride contents of 3 mg/1 and 10 mg/1 and pH values of 6.3-6.5. Filter lifetimes were about 30 days. About 10 liters of 2 N sodium hydroxide per kg aluminum oxide were required for regeneration. Accumulation of fluoride by the adsorbent from the rinse water can be prevented by using rinse water with pH values in excess of about 7.5. Fluoride ion removal is not selective, but hydrogen arsenate and hydrogen phosphate are also removed to a high degree. Changes in other mineral constituents were not observed. The increase in aluminum content in the filtered water samples amounted to about 0.1 mg/1. (Carroll-FRC)
W82-04578

SLOW-SAND TEST-BEDS HELP REFINE DESIGN,
A. Raman, G. Singh, and J. L. Nagpal.
World Water, Vol 4, No 12, p 44-45, December, 1981. 2 Fig.

Descriptors: *Water treatment, *Rural areas, *Pilot plants, *Sand filters, Filtration, Water supply, Raw water, Filters, Separation techniques, Control systems, Chlorination, Design criteria, Abub Shahar, *India.

In designing the Abub Shahar water treatment demonstration plant in India, the lack of skilled staff and possibility of discontinuous terminal chlorination were taken into account. The filters function mainly for polishing and bacterial purification. Raw water in a storage tank is filtered 24 hr per day by four circular filters with one as a standby. The filtered water is chlorinated and held in two clearwater tanks until distribution to the rural villages. The Abub Shahar village demonstration plant has experienced vagaries of electric power supply since it began operation in June of 1979. Although backup diesel generators can be used, extra capacity capabilities could be supplied to the plant's different units to satisfy about 66% of design demand during these adverse periods. The backup filter is being operated constantly, and the high-level tank lacks a float valve on the outlet. A partially above ground filter would have been more appropriate to facilitate scouring of supernatant water. A master sluice valve to control raw water pumping and overflows in all the filters are suggested to improve flow regulation. A separate supernatant scour-out box combined with filter overflow and a modified outlet arrangement incorporating rate-limiting and measuring orifices in the backfilling pipe are also proposed. (Geiger-FRC)
W82-04614

FLOCCULATION IN PIPES FOR WATER POLLUTION CONTROL AND PHOSPHORUS REMOVAL PURPOSES (UBER DIE ANWENDUNG DER FLOCKENBILDUNG IN ROHREN ZUR WASSERREINHALTUNG UND PHOSPHATELIMINATION),
Bundesgesundheitsamt, Berlin (Germany, F.R.).
Inst. fuer Wasser-, Boden- und Lufthygiene.
A. Grohmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 194-209, 1981. 15 Fig, 3 Tab, 16 Ref.

Descriptors: *Water treatment, *Flocculation, *Design criteria, Wastewater treatment, Water treatment facilities, Laboratory studies, Separation techniques, Chemical coagulation, Pilot plants, *Phosphate removal, Industrial wastewater, *Water pollution control.

The possibility of performing flocculation in pipes offers a means of significantly accelerating the flocculation process, since the velocity gradients in pipes enhance agglomeration of microflocs. A pipe length of 40 m will allow an adequate safety margin for maintenance of flocculation, since a steady state of floc growth versus breakup is reached in approximately 20 m. Adequate colloid and precipitation products destabilization is required. In addition to rising velocity gradients, addition of anionic polyacrylamides will also increase floc size. The design selected must provide sufficient turbulence to bring microflocs into contact with one another, but not to destroy flocs already formed. Design and operation data are presented for a trailer-mounted water treatment pilot plant and an industrial water treatment plant. Data are also tabulated for pipe flocculation systems ranging from laboratory tests with model colloids to full-scale water and wastewater treatment plants. Pipe sizes ranged from 8 to 600 mm diameter. Typical values obtained were flocs of 2-3 mm with a settling rate of 10 m/hr and a residual turbidity (after 10 min standing) of 1.5 formazin units, at an anionic polyacrylamide addition rate of 0.5 g/cu m and a mean flow velocity gradient of 70/sec. (Carroll-FRC)
W82-04615

TANZANIA'S MASTER WATER PLAN WILL MISS DECADE GOAL,
R. Laishey.
Water, No 42, p 26-27, 1982.

Descriptors: *Developing countries, *Water supply development, Potable water, Drinking water, Water supply, *Tanzania, Shallow wells, Wells.

In 1977, 90% of the rural population of Tanzania was living in village settlements, and the government was attempting to supply them with safe potable water. The country had announced an ambitious water plan in 1977, with a target date of 1991 as the year by which all the rural population would be within 400 meters of safe potable water. In 1973 the first phase of the scheme began, with the drawing up of a master plan for each of the 20 regions of the country. By the beginning of the 1980s, 12 regions were equipped with paster plans, another five were under preparation and for three no plans had yet gotten underway. A Master Plan Coordination Unit was established to oversee the project and gather the needed funding. Officially some six to seven million people or just under 40% of the rural population are now within 400 meters of potable water. In reality the figure may be closer to three to four million. Part of the problem is cost. Experiments are being conducted with cheaper technologies and self-help schemes. It is believed that the shallow well scheme can reach some 50% of the population in rural areas, but shallow wells have serious drawbacks. One well can probably only efficiently serve a village of 1,500 people. Many villages have 2,000 or more people. (Baker-FRC)
W82-04657

COLLOIDAL ORGANICS,
Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 113, No 2, p 65-67, 1982. 2 Fig, 8 Ref.

Descriptors: *Colloids, *Organic matter, Decomposing organic matter, Litter, Taste, *Water treatment, *Water quality, Odor control, Odor-producing algae, Odors, Coagulation.

Relatively high concentrations of organic colloids in a water supply are troublesome and should be removed for the following health and esthetic reasons: taste and odor problems are largely due to colloidal organics, byproducts of algae, diatoms, and actinomycetes, which produce objectional tastes and odors; humic and fulvic acids are precursors of chloroform; colloidal organics produce undesirable colors in water; colloidal organics cause fouling of anion exchangers and interfere with the demineralization of water; metal complexes of organic colloids strongly influence metal distribution between the dissolved and particulate state; the presence of colloidal organics can shield waterborne pathogens from disinfection treatment and can create problems associated with biological quality of treated water; and colloidal organics interfere with oxidation and removal of iron and manganese from water. Most organic substances produced by plants and animals in lakes and rivers and those brought there from the outside, such as leaf litter, are eventually decomposed through the metabolism of various aquatic organisms such as bacteria and fungi. Since the electrically charged surfaces of colloidal particles cause them to repel one another and maintain the stability of a colloidal dispersion, neutralization of the charged surfaces would permit the colloidal particles to come together and be removed from a water supply. The removal of colloids in this manner can be accomplished by coagulation. Various hypothetical models have been proposed to explain the destabilization and initial aggregation of colloidal matter by the addition of coagulants. (Baker-FRC)
W82-04689

YEAR-ROUND DISTRIBUTION SYSTEM MAINTENANCE,
Connecticut Water Co., Clinton.
J. E. Lebert, Jr.
Journal of the New England Water Works Association, Vol 95, No 4, p 267-270, December, 1981.

Descriptors: *Water conveyance, *Maintenance, Water distribution, *Water mains, Water supply systems, Management planning, Materials, Iron, Corrosion, Saline water, *Guilford-Chester Division, Connecticut Water Company, *Connecticut.

A review is presented of the last 15 years of year round distribution system maintenance carried out by the Connecticut Water Company, Guilford-Chester Division. During this time over 37,000 feet of 2, 4 and 6 inch cast iron and galvanized iron main was replaced with 8 inch or larger ductile iron mains. All new water mains in the salt water areas have been transilwrapped for protection. Larger mains have provided greater fire protection and a better quality of water, as they are all cement lined. Many dead ends were also tied in to improve fire protection and quality. Every service on the replacement mains was also replaced with copper tubing or plastic tubing. Crew size has been kept low, primarily due to the replacement vs repair program. Work is very seldom interrupted to make an emergency repair. A winter and spring maintenance program has been devised to make the best use of the time available. A program of replacing or repairing bridge crossing, culvert crossings, and river crossings has also been started. The policy aims at repairing or replacing before a problem occurs. (Baker-FRC)
W82-04699

REACTION OF OZONE WITH TRANS,TRANS-MUCONIC ACID IN AQUEOUS SOLUTION,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
E. Gilbert.
Water Research, Vol 14, No 11, p 1637-1643, November, 1980. 8 Fig, 3 Tab, 13 Ref.

Descriptors: *Ozone, *Organic compounds, *Oxidation, *Water treatment, Aromatic compounds, Muconic acid, Peroxides, Chemical degradation, Degradation products, *Ozonation, Drinking water, Chemical reactions, Phenols, Kinetics.

Ozonation of trans,trans-muconic acid in aqueous solution at pH 3 leads to the formation of fumaric acid aldehyde, glyoxal, glyoxylic acid and formic acid. As the reaction progresses, these are oxidized to the stable end products oxalic acid, mesoxalic acid and carbon dioxide. Hydrogen peroxide has been observed, in addition to unstable organic peroxides. Organic peroxides are not observed in the case of ozonation at pH 7-8, and the amounts of organic peroxides formed in this case are smaller than at pH 3. Up to the point of complete elimination of muconic acid the specific ozone consumption was 3.2 mmol ozone per mmol acid. Quantitative analysis of the oxidation products indicated that the ring opening products initially formed are further oxidized during ozonation, resulting in very low steady state concentrations in the course of ozonation at high ozone doses and low initial concentrations of aromatics to be oxidized. (Carroll-FRC)
W82-04731

5G. Water Quality Control

WATER MANAGEMENT IN ONTARIO,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 6E.
W82-04259

STRATEGIES TO CONTROL NONPOINT SOURCE WATER POLLUTION,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
J. J. Peirce.
Water Resources Bulletin, Vol 16, No 2, p 220-225, April, 1980. 1 Tab.

Descriptors: *Water pollution control, *Nonpoint pollution sources, Regulations, Environmental management, *Regional planning, Planning, Water quality control, Management, Water policy, Research priorities, Monitoring, New York, Virginia, Wisconsin, Urban runoff.

Strategies for nonpoint source water pollution control are discussed for three representative states, Virginia, New York, and Wisconsin. The most significant nonpoint pollution source in these states is urban storm water runoff, including combined sewer overflows. Others are silviculture activities, construction, mining activities, on-site wastewater treatment facilities, disposal of municipal and industrial sludge and refuse, and agricultural runoff. A complete range of control strategies is illustrated, from voluntary compliance to strict regulations. Virginia favors voluntary action, Wisconsin plans to implement strict regulations if voluntary compliance is ineffective, and New York favors voluntary compliance combined with some regulations. A study of the programs and agencies in these states indicates: (1) nonpoint sources of pollution are a major component of overall water pollution, (2) technology exists to control these problems, (3) present control programs are not always technologically sound or cost effective, and (4) existing control programs will work only if meaningful actions take place in the future (voluntary compliance and effective implementation of regulations). (Cassar-FRC)
W82-04261

APPLICATION OF THE OECD EUTROPHICATION MODELING APPROACH TO LAKE RAY HUBBARD, TEXAS,
Brown and Caldwell, Sacramento, CA.
For primary bibliographic entry see Field 5C.
W82-04278

USE OF ACTIVE ALUMINA FILTRATION FOR REMOVING PHOSPHATES FROM SMALL INFLUENTS INTO AN IMPOUNDING RESERVOIR (ANWENDUNG DER AKTIVTONERDEFILTRATION ZUR ELIMINERUNG VON PHOSPHATEN AUS KLEINEN TALSPERRENZULAUFEN),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt, S. Fberle, D. Donnert, H. Struwe, and A. Wilhelms.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 180-187, 1981. 9 Fig, 4 Tab, 7 Ref.

Descriptors: *Watershed protection, *Reservoirs, *Phosphate removal, *Fish ponds, Adsorbents, Activated alumina, Filtration, Impoundments, Nonpoint pollution sources, Aluminum compounds, Nitrification, Ammonium, Receiving waters, Germany.

Fish ponds can represent significant sources of pollutants, especially phosphorus compounds and ammonia, in receiving waters. In 1987-1980 a hatchery located on the Derenbach introduced 55-65 kg of total phosphorus per year into an impounding reservoir located on the Wahnbach, contributing significantly to algal growth in the reservoir. Gravity filtration units were designed and inserted in the fish pond effluent line. The filters had a total surface area of 24 sq m and contained 19.8 metric tons of activated alumina. Filtration speed was conrolled to achieve satisfactory phosphate elimination and ammonium removal by nitrification. Filters were back-washed every 4 weeks with pond water; the back-wash water and sludge were returned to the main pond. Over the 10-month operation period, average orthophosphate removals of 83% were achieved, and average total phosphate removals of 77%. The effluent orthophosphate concentration was approximately equal to the desired value of 50 microg/liter. About 40% of the total organic carbon was also removed. Unexpectedly high ammonium ion removals were also attained, ranging up to 90%. No increase in aluminum level was recorded in the effluent. lgal clogging of the filter can be reduced by excluding light. Operating costs were estimated at 0.05 German Marks per cu m of filtered water. The filtration unit is still operating satisfactorily after one year. (Carroll-FRC)
W82-04281

ANALYTICAL QUALITY CONTROL,
D. Hunt.
Water, Vol 41, p 17-19, November, 1981. 3 Fig.

Descriptors: *Quality control, *Water analysis, Pollutant identification, Precision, Accuracy, Standard deviation, Laboratories, *Water quality control.

Analytical quality control in the water industry is necessary because there are many sources of ana-

lytical error--the analyst, the method, instruments, and contamination. The Water Research Council recommends a method for achieving comparability of analytical results from several laboratories. A working group defines the analytical objectives, chooses the most suitable method or develops a new one, ensures that instructions for methods are complete and clear, estimates standard deviation, compares standard solutions used by all laboratories, ets up control charts for systematic analysis of known solutions, and estimates the bias of each laboratory. A group of laboratories using quality conrol wqs far superior in analyzing a known lead solution when compared with a group not applying a quality control scheme. (Cassar-FRC)
W82-04345

PONDING SURFACE DRAINAGE WATER FOR SEDIMENT AND PHOSPHORUS REMOVAL,
Snake River Conservation Research Center, Kimberly, ID.
For primary bibliographic entry see Field 4D.
W82-04358

WATER-QUALITY PROBLEMS AND MANAGEMENT OF AN URBAN WATERFOWL SANCTUARY,
Wisconsin Univ. Green Bay. Coll. of Environmental Science.
H. J. Harris, Jr., J. A. Ladowski, and D. J. Worden.
Journal of Wildlife Management, Vol 45, No 2, p 501-507, 1981. 8 Fig, 22 Ref.

Descriptors: *Ponds, *Eutrophication, Nutrients, Birds, Water birds, *Waterfowl, *Water pollution sources, Wildlife habitats, Wildlife, Wildlife conservation, *Beach Wildlife Sanctuary, Green Bay, Wisconsin, *Water quality control.

The effects of waterfowl on water quality of an urban waterfowl sanctuary and the effectiveness of dredging as a renovation technique were investigated. The study was conducted at the Bay Beach Wildlife Sanctuary, Green Bay, Wisconsin. The sanctuary is a complex of interconnected manmade ponds surrounded by urban open space, including wetlands. Sources of water for all ponds are rain, runoff, and groundwater, with no connection between the ponds and Green Bay. Waterfowl use was estimated by direct counts several times a month over a 4 year period, usually taken at the time of water sampling. There were large differences in intensity of waterfowl use between the two ponds selected for study, one of which (N) was dredged, while the other (L) served as control. The estimated average annual use of N over a 4 yr period was 180,000 waterfowl days, whereas the use of L was 31 waterfowl days. Calculated annual loading from waterfowl in N amounted to 378 kg of total phosphate, 378 kg total nitrogen, and 7,830 kg of total solids. For L, comparable fiures were 0.065 kg phosphate, 0.065 kg total nitrogen, and 1.35 kg total solids. A sharp decrease in total phosphate and nitrate-nitrogen was noted in N the year following dredging. A marked decline in chlorophyll a was also noted in N after dredging and was correlated with decrease in the number of phytoplankton units/liter of water in the year following dredging. Diversity of phytoplankton, however, increased. While it may be assumed that waterfowl act as a nutrient source and bring small ponds to eutrophication, the key finding of this study was that eutrophication can and does occur rapidly under certain conditions. This is critical in the design and operation of waterfowl urban sanctuaries. (Baker-FRC)
W82-04384

AERATION CHARACTERISTICS OF FLOW RELEASE CONTROLS ON ILLINOIS WATERWAY DAMS,
Illinois State Water Survey, Urbana.
T. A. Butts, and R. L. Evans.
Circular 145, 1980. 69 p, 7 Fig, 24 Tab, 18 Ref, 7 Append.

Descriptors: *Dams, *Flow control, *Reservoir releases, *Dissolved oxygen, *Aeration, *Spillway gates, Discharge coefficient, Water quality, Weirs, Locks, Flow measurement, Spillways, Diversion, On-site data collections, *Water quality control, *Illinois waterway dams.

One of the most obvious and direct effects dams have on water quality is the creation of abrupt changes in dissolved oxygen (DO) concentrations. This study's main objectives were to gather physical and chemical data for use in a dam aeration calibration procedure based on a weir formula developed in Great Britain, and to evaluate the effects of increased Lake Michigan diversion water on the dam aeration characteristics. On-site DO and temperature measurements were taken above and below flow release structures and in calibrated weir boxes at seven dams. Water flowing over weirs or through head-loss control structures, such as Tainter and sluice gates, can be aerated or deaerated depending upon the ambient upstream DO concentration. Smaller gate openings consistently had greater reaeration capacities (approximately twice the oxygen transfer efficiency) than larger openings, i.e., the aeration efficiency is inversely related to opening size. This means more efficient aeration could be achieved by using the smallest opening possible while maintaining a desired downstream flow. For example, if 8 feet of opening is required at Starved Rock, 8 gates opened at one foot would be better than two gates at 4 feet, or two at 3 feet and one at 2 feet. However, dam aeration coefficients derived varied significantly within a dam, depending on the mode of operation, and varied greatly between dams. It was determined that under current operating modes the aeration capabilities of the flow release structures at the dams above the LaGrange and Alton pools will be significantly lowered by increasing diversion to 10,000 cfs. (Atkins-Omniplan)
W82-04388

DESIGN OPTIMIZATION OF THE CHLORINATION PROCESS: VOLUME 1. COMPARISON OF OPTIMIZED PILOT SYSTEM WITH EXISTING FULL-SCALE SYSTEMS,
California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 5D.
W82-04399

A STRESS FUNCTION FOR EVALUATING STRATEGIES FOR WATER QUALITY MANAGEMENT,
Illinois Natural History Survey, Urbana.
For primary bibliographic entry see Field 5C.
W82-04407

COVERING BOTTOM SEDIMENTS AS A LAKE RESTORATION TECHNIQUE,
Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke.
Water resources Bulletin, Vol 16, No 5, p 921-926, October, 1980. 3 Tab, 28 Ref.

Descriptors: *Eutrophication, *Water pollution prevention, *Lakes, *Linings, Nutrients, *Sediment covers, *Sediments, Bottom sediments, Water resources development, Recreation facilities, Plastics, Macrophytes, Nutrients.

Sediment covering has been suggested for controlling macrophytes and sediment nutrient release in order to effect lake restoration. The application of fly ash to control sediment phosphorus release apparently introduces more problems than it solves and should not be used. The possible adverse effects of fly ash application include high pH, dissolved oxygen depletion, biological reduction of sulfate to sulfide, heavy metal accumulation and toxicity, and physical clogging and crushing of organisms. Plastic sheeting has been suggested as a potentially effective technique to control macrophytes and nutrient release. Sand covered sheeting may also be useful in construction of swimming beaches. The largest scale reported experience with sheeting was the Marion Millpond, Wisconsin, where a black polyethylene sheet was used over ten hectares to control or retard macrophyte regrowth. In March of 1978 a finely porous compound, spun bonded DuPont Typar 3201 and 3202 black polypropylene, was applied to exposed sediments of Country Lake in Ohio. Further evaluation of this project is needed. Polyvinyl chloride has also been used. The use of plastic sheeting for control of macrophytes and sediment nutrient release has received insufficient evaluation to make conclusions about effectiveness, duration, application, and cost problems. Very little published information exists about the use of clays or sand to retard nutrient release or macrophyte growth. Heavier materials such as sand are apparently ineffective, as they sink into flocculent sediments. (Baker-FRC)
W82-04421

EVALUATION AND TREATMENT OF SYNTHETIC ORGANICS IN DRINKING WATER SUPPLIES,
Montgomery (James M.), Pasadena, CA.
For primary bibliographic entry see Field 5F.
W82-04427

MODELED IMPACTS OF SURFACE COAL MINING ON DISSOLVED SOLIDS IN THE TONGUE RIVER, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
P. F. Woods.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117771, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-64, October, 1981. 73 p, 3 Fig, 33 Tab, 39 Ref.

Descriptors: *Computer models, *Coal mines, *Strip mines, *Dissolved solids, Leaching, Salinity, Irrigation effects, Streamflow, Irrigation water, Selective withdrawal, Return flow, Reservoirs, *Montana, Tongue River, *Water quality control.

A computer model has been developed for spatial and temporal simulation of streamflow and dissolved solids in the Tongue River from the Tongue River Dam to Miles City, Montana. User-defined plans of surface coal mining and agricultural development permit evaluation of potential changes in dissolved solids resulting from leaching of overburden material used to backfill mine pits and from withdrawal and return flow of irrigation water. Provision is made for simulation runs using increased streamflow from a proposed larger reservoir intended to replace the present Tongue River Reservoir. Simulations at mean streamflow indicated that mining 119,600 acres of federally leased coal tracts may increase by 4.8 percent the present annual dissolved-solids concentration in the Tongue River at Miles City. Simulations using the proposed Tongue River reservoir show substantial reductions in dissolved-solids concentration when paired with similar simulations using the present Tongue River Reservoir. When compared on a per-acre basis for the study area, the dewatering caused by irrigation increases dissolved-solids concentration more than the input of leachates from surface coal-mining operations. (USGS)
W82-04494

QUALITY OF SURFACE WATER IN THE COAL-MINING AREAS OF WESTERN MARYLAND AND ADJACENT AREAS OF PENNSYLVANIA AND WEST VIRGINIA FROM APRIL 1979 TO JUNE 1980,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04516

ROADS IN WATER-PROCURING REGIONS - WATER POLLUTION CONTROL AND SAFEGUARDING OF WATER SUPPLY, EXEMPLIFIED BY THE STUTTGART-SINGEN AUTOBAHN (STRASSEN IN WASSERGEWINNUNGSGEBIETEN- GEWASSERSCHUTZ UND SICHERSTELLUNG DER WASSERVERSORGUNG AM BEISPIEL DER AUTOBAHN A 81 STUTTGART-SINGEN),
Tubingen Regierungspresidium (Germany, F.R.).
For primary bibliographic entry see Field 4B.
W82-04551

WHO WINS IN THE FIGHT FOR POLLUTION CONTROL,
For primary bibliographic entry see Field 6B.
W82-04554

TELEMETRIC WATER CONTROL SYSTEM OF THE ARTIFICIALLY AERATED MOSEL RIVER,
Landesamt fuer Gewasserkunde, Mainz (Germany, F.R.).
H. Kalweit.
Water Science and Technology, Vol 13, No 11/12, p 645-650, 1981. 4 Fig.

Descriptors: *Telemetry, *Water management, Oxygen, *Aeration, Remote sensing, Computers, Automation, *Water pollution control, Rivers, *Mosel River, Weirs, Spillways, Water pollution sources, Wastewater, Navigation, Plankton, *Germany.

A temporary but substantial deterioration of the oxygen balance has been noted in the Mosel River due to weir steps which were constructed to aid in the use of the river for navigational and hydroelectric purposes. The river is loaded by sewage effluent and self polluted by plankton. Overspill has been provided at the barrages to alow artificial aeration to be carried out, thus increasing the oxygen content of the river water. The overspilling is to the debit of hydropower and should thus be as small as possible but sufficient for river protection. An accurate adaptation to the aeration demand has to be figured temporally and locally. Such aeration is needed mainly during the nighttime hours. In individual impounding sections very different oxygen contents can occur at the same time. Therefore it is necessary to gain information at several points. The staff at the hydropower stations needs information on the amount of aeration water, on the weirs and the hours of overspill 12 to 24 hr in advance. The data is gained through a telemetric system. Automatic data transmission was begun in August 1978. The system works nearly without loss of data. The transmission has been interrupted several times by lightning. (Baker-FRC)
W82-04598

FLOCCULATION IN PIPES FOR WATER POLLUTION CONTROL AND PHOSPHORUS REMOVAL PURPOSES (UBER DIE ANWENDUNG DER FLOCKENBILDUNG IN ROHREN ZUR WASSERREINHALTUNG UND PHOSPHATELIMINATION),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5F.
W82-04615

PERFORMANCE TESTING OF THE SOVIET OIL/DEBRIS SKIMMER,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
H. W. Lichte.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-244790, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency EPA-600/S2-81-154, September, 1981. 4 p, 2 Fig. 68-03-2642.

Descriptors: *Oil skimmers, *Oil spills, *Cleanup operations, Oil recovery, Oil pollution, Viscosity, Harbors, Water pollution control, *USSR.

The oil skimming capability of a specially modified Soviet oil/debris skimmer was investigated at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) in 1979. The self-propelled vessel is 17.7 m long and weighs 39 metric tons. The 111-kw diesel engine drives a ducted propeller, water jet propulsion system. The vessel is capable of 5 knots forward speed and skims effectively at speeds of 0 to 1.0 m/s. The unique combination of various weir designs into one system, vessel mobility, the efficient use of energy, a series-type of oil/water gravity separator, and the propulsion techniques all suggest that this model is an effective harbor skimmer. The oil recover rate of 12.4 cu m/hr was confirmed using high-viscosity test oil in calm water conditions. Recovery efficiency was 85% at 0.77 m/s forward speed, and throughout efficiency was 90% at 0.51 m/s forward speed. Performance dropped when low-viscosity oils were skimmed at faster speeds and higher wave conditions. The skimmer collected 64% of the 81.3 cu m oil volume encountered during the test program. (Moore-SRC)
W82-04621

APPLICATION OF THE AREA OF REVIEW CONCEPT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 6E.
W82-04674

EXPERIENCES WITH FLOATING RESERVOIR COVERS AT THE MANCHESTER WATER WORKS,
Manchester Water Works, NH.
D. Kittredge.
Journal of the New England Water Works Association, Vol 95, No 4, p 258-263, December, 1981. 1 Tab.

Descriptors: *Reservoirs, *Water pollution sources, Reservoir operation, Surface water, Drinking water, Water quality, *Manchester, New Hampshire.

Pollution of open reservoirs by airborne matter, birds and animals and often by man himself has been a problem at the Manchester Water Works for a number of years. A decision was reached in 1969 to install a system of synthetic rubber floating covers over the three open reservoirs as the first phase of a general improvement plan to upgrade and protect water quality. The second phase of the plan involved construction of a complete and modern water filtration system. The Manchester Water System consists of more than 355 miles of mains ranging in diameter from 2 to 36 inches and three principal water distribution reservoirs with a combined storage capacity of 41 MG. The first winter of floating cover operation was a severe test, with a prolonged cold spell of sub-zero weather lasting most of the month of February, resulting in a massive ice buildup along reservoir walls. Several large tears were noted in the cover membrane the following spring. Extensive ice and vandalism caused one of the covers to be removed in 1979. The condition of the remaining two covers is questionable, but the utility estimates a total life expectancy of 10-12 years. During the first year of floating cover operation, bacterial quality of treated water improved substantially, chlorination dosages were lowered, and as a result chemical costs were reduced by about 44%. (Baker-FRC)
W82-04697

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION: STATE OF THE ART,
New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 6E.
W82-04700

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION, DESIGN ASPECTS AND ALTERNATIVES,
Whitman and Howard, Inc., Wellesley, MA.
J. Murphy.
Journal of the New England Water Works Association, Vol 95, No 4, p 248-252, December, 1981.

Descriptors: *Reservoirs, Water supply development, Water quality, Water pollution sources, *Water pollution control, *Water supply systems, *Reservoir covers, *New England, Design criteria.

Some of the concepts and problems which must be considered during the design of various covering systems for reservoirs are discussed. One of the earliest steps in the process is to evaluate the problems that the cover is supposed to correct. These may include airborne contaminants, surface runoff, ground-water, vandalism, birds, animals, and aquatic organisms. Open reservoirs which can be evaluated in terms of cost effectiveness of covering are usually among the following: steel reservoirs, concrete reservoirs, and earthen reservoirs. An evaluation of the type of roof system to employ for an open water distribution reservoir must consider such factors as foundation soils, access to the area, location of the facility both from the standpoint of vandalism and topography, climate of the area, dead and live load requirements, the life of various construction materials, the aesthetics of the completed facility, the down-time required for construction, and finally, the relative costs of the various systems. (Baker-FRC)
W82-04701

THE ROOFLOAT (FLOATING) COVER SYSTEM FOR LIQUID STORAGE,
Globe Linings Inc., Long Beach, CA.
W. B. Kays.
Journal of the New England Water Works Association, Vol 95, No 4, p 253-257, December, 1981.

Descriptors: *Reservoirs, Water supply development, Water quality, Water pollution sources, Water resources development, Water storage, *Water pollution control, Reservoir covers, *Design criteria, Economic aspects, Water supply.

An attempt was made to develop alternatives to the conventional roof structure for reservoirs. In examining the possibilities of an inflated membrane, the largest drawback appeared to be the high-rise feature. Reservoir owners demanded a flat or nearly-flat profile to ease public relations problems. A compromise was worked out to a 10% rie which owners had to accept if they wished to benefit from the lower costs and other advantages associated with the inflatable roof. The coated fabric that gave the best combination of availability, low cost and high strength was the popular 22/24 oz per sq yd construction, using a 5.5 oz nylon with a 60:40 unbalanced white PVC coating. Disadvantages of this material outweighed the advantages, and a new flexible floating cover system, ROOFLOAT, was designed. The ROOFLOAT cover is essentially a stress-free system. As further developments are made, the following qualifications for a cover should be met: a high degree of outdoor weatherability, with a 50 yr minimum life expectancy in all climates; a relatively simple and effective field and factory seaming procedure that will yield joints that cannot fail; possible field installation at all temperatures above freezing; no delamination of reinforcement fibers or membrane plies; easy repair of the membrane at any age; and physical properties which would allow the aforementioned conditions to be met. (Baker-FRC)
W82-04702

SURROGATE PARAMETER ANALYSIS FOR ORGANIC PRIORITY POLLUTANTS,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-04704

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

AREAWIDE STORMWATER POLLUTION ANALYSIS WITH THE MACROSCOPIC PLANNING (ABMAC) MODEL,
RAMLIT Associates, Berkeley, CA.
For primary bibliographic entry see Field 5B.
W82-04393

STOCHASTIC STATE VARIABLE DYNAMIC PROGRAMMING FOR RESERVOIR SYSTEMS ANALYSIS,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, and V. T. Chow.
Water Resources Research, Vol 17, No 6, p 1578-1584, December, 1981. 5 fig, 1 Tab, 21 Ref.

Descriptors: *Reservoir management, *Operating policies, *Reservoir releases, Reservoir operation, Reservoir storage, *Dynamic programming, Watasheamu Dam, Nevada, Model studies, Stochastic analysis, Markov process, Hydroelectric plants, Electric power production, Systems analysis, Optimization, *Multipurpose reservoirs.

The concept of the state of a system was used to link together state space modeling, dynamic programming, and Markov chain analysis for optimization of reservoir systems in monthly stages over a year. The mathematical description of the inflows to the reservoir system and the response of the system to inflow and releases were formulated as the state space model. This was incorporated within an explicit dynamic programming procedure as the state transition equation. Transition probabilities of the state variables were found for each decision and tested in dynamic programming. Those for the optimal decisions were used in a Markov chain analysis to determine the statistical characteristics of the state and decision variables if the reservoir is operated for a long period with the optimized policy. This method was used to determine the operating policies for the proposed Wastasheamu Dam, Nevada, designed for irrigation water supply, hydroelectric power, and flood control. Operating policies developed by two techniques, independently distributed or serially correlated monthly flows, were similar over the midrange of flows but different for very high and low inflows. chance constraints were used to avoid the probability that storage would be outside the desired range. These constraints may be varied to obtain tradeoffs between economic efficiency benefits and the risk of violating storage limits. (Cassar-FRC)
W82-04430

THE REPRESENTATION OF VARIABLE HYDRO POTENTIAL IN LONG-RANGE ELECTRICITY PLANNING MODELS,
Victoria Univ., Wellington (New Zealand). Dept. of Information Science.
B. R. Smith.
Energy, Vol 6, No 4, p 323-331, 1981. 3 Fig, 8 Ref.

Descriptors: *Hydroelectric power, *Model studies, *Drought, Long-term planning, Planning, Energy, Electric power production, Linear programming, *Capital costs, Operating costs, Costs, Fuel, *New Zealand.

A linear programming model for long-range planning of electricity generation in areas with a high proportion of hydro power is presented. It considers the effects of both low and high water inflows. Increases in model size are kept to a minimum. This is important in large time-staged models and in multi-fuel supply models. The least cost choice for reserve capacity must account for capital costs of the generating capacity, but also the fuel and operating costs incurred when water intake is low. The model described herein has been implemented in a multi-fuel model of the New Zealand energy system. (Cassar-FRC)
W82-04474

MULTIPERIOD DESIGN OF REGIONAL WASTEWATER SYSTEMS: GENERATING AND EVALUATING ALTERNATIVE PLANTS,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W82-04562

A MULTIOBJECTIVE BRANCH AND BOUND METHOD FOR NETWORK-STRUCTURED WATER RESOURCES PLANNING PROBLEMS,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
M. Nakamura, and J. M. Riley.
Water Resources Research, Vol 17, No 5, p 1349-1359, October, 1981. 4 Fig, 5 Tab, 11 Ref. OWRT A083-KY.

Descriptors: Planning, *Water resources development, Resources development, *Multiobjective planning, Water supply development, Model studies, Computers, Flow, *Network design.

A multiobjective branch and bound method is proposed for analyzing problems involving a network flow structure which are commonly found in the water resources planning field. The method appears to be computationally efficient due to the special problem structure associated with the nonlinear network flow formulation. The method was successfully applied to a realistic regional wastewater planning problem of a moderate size. Also proposed is a multiobjective imputed value analysis which makes use of the branch and bound tree structure and allows comparison of the importance of facilities in the network as represented by individual arcs or sets of arcs. The mathematical formulation and the analysis procedure of the method are described, and the potential usefulness is demonstrated. A Fortran program for implementing the algorithm is available and was used to analyze the example problem consisting of about 650 executable statements. It is an interactive program which provides information on the growth of multiobjective branch and bound trees and the generation of noninferior alternatives in the process of computation. (Baker-FRC)
W82-04563

WATER REUSE PLANNING MODELS: EXTENSIONS AND APPLICATIONS,
Texas Univ. at Austin. Dept. of Civil Engineering.
G. Ocanas, and L. W. Mays.
Water Resources Research, Vol 17 No 5, p 1311-1327, October, 1981. 7 fig, 8 Tab, 14 Ref. OWRT 14-34-0001-9483.

Descriptors: *Model studies, *Water reuse, Decision making, Planning, Wastewater treatment, Water treatment facilities, Sinks.

This paper presents a real world application of both the single period and the multiperiod planning models to a region that includes the City of San Antonio, Texas. The use of the single period model is shown through a set of different planning scenarios for the years 1980, 2000, and 2030. The multiperiod model was applied to a planning horizon consisting of three planning periods beginning in the years 1980, 2000, and 2030. The optimal capacity expansion of treatment facilities was determined, considering the capacities already available at the beginning of the planning horizon. The system consists of many elements: water sources, water treatment plants, wastewater treatment plants, and water sinks. The following conclusions were drawn from the study. Optimal water allocation planning should incorporate both water and wastewater systems conjunctively to better assess the impact of water reuse. Economies of scale have a significant effect on the cost and consequently the configuration of the water systems. The solution of a sequence of independent single period problems does not provide an accurate representation of the growing nature of the system. Therefore single-period planning is best suited to assess the impacts of different planning scenarios under current conditions. The performance of the solution algorithm was apparently influenced by the selection of the initial point. The final solution can be dependent upon the specified initial solution, indicating the importance of selecting a good initial point. The model, however, does not provide the ultimate answer to the problem of water allocation and capacity expansion within a region. The model is deterministic; no stochastic or seasonal variations are included. Finally, the model does not guarantee global optimality due to the nonconvex structure of the constraint set and the concavity of the objective function when economies of scale are incorporated. (Baker-FRC)
W82-04565

TRANSGLOBAL VARIATIONS IN THE PLANNING OBJECTIVES AND CRITIQUES,
Ministry of Water and Power, Islamabad (Pakistan).
S. M. H. Bokhari.
Water Supply and Management, Vol 5, No 6, p 377-389, 1981. 22 Ref.

Descriptors: *Water management, *Water policy, *Planning, *Pakistan, Agriculture, Water resources development, Indus Basin, Environmental quality, Economic development, Social aspects, Political aspects, Technology, Water law, Comparison studies, United States.

The history and present state of planning and management of water resources is contrasted for Pakistan and the U.S., two countries with greatly differing economic and social conditions. In the early U.S. planning was almost nonexistent on a federal scale. Water resources were regarded as exploitable for economic development. The battle between conservationists and developers began early in the 20th century and reached a climax during the 1960's. During the 1930's regional and multi-purpose development projects were popular. In 1973 the Water Resource Council adopted two planning objectives, national economic development and environmental quality. Pakistan's history of water resources planning objectives includes the British colonial period 1856-1947, during which the few water projects were greatly underdesigned, wasteful, nonscientific, and without regard to future problems such as waterlogging and salinity of the soil. Investments were minimized. A Development Board was created a year after Independence to prepare a 5-year plan. These plans have been prepared regularly since 1955. Objectives for water resources development included conservation, development of new surface and groundwater resources, increasing irrigated areas, reclamation of waterlogged and saline soils, flood and erosion control, and a research program. Project evaluation in Pakistan is based on benefit-cost analysis. The many differences in background and policy between the two countries make it impossible to effectively apply planning objectives from the U.S. in the developing countries. (Cassar-FRC)
W82-04605

SIMULATED INTERACTIONS BETWEEN THE PROPOSED NARROWS RESERVOIR AND THE WATER-TABLE AQUIFER ALONG THE SOUTH PLATTE RIVER, MORGAN COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
A. W. Burns.
Geological Survey Water-Resources Investigations 80-119, 1981. 61 p, 24 Fig, 11 Tab, 9 Ref.

Descriptors: *Model studies, *Preimpoundment, *Water table, *Surface-groundwater relations, Simulation analysis, Forecasting, Reservoirs, Dams, *Colorado, Morgan County, Narrows Reservoir, *South Platte River, Groundwater movement.

A computer model, including a ground-water-flow component and a mass balance reservoir-operations component, was developed to simulate the proposed Narrows Reservoir and the adjacent alluvial aquifer of the South Platte River, Morgan County, Colo. This model, using a weekly time step, simulated the transient interactions of these two systems for an initial-fill condition and general-operational condition. A sensitivity analysis was made to test the effects of possible errors in the description of aquifer characteristics on the model results. The initial-fill simulation indicated that to fill the reservoir when hydraulic connection between the surface-water system and the aquifer is simulated would take 2 additional years than if no connection was assumed. Simulated ground-water return flow to the river downstream of the proposed dam was about 85 percent of the estimated maximum values, computed under steady-state conditions in an earlier study. The general operation simulation indicated that during the period of lowest reservoir contents the aquifer provided about 80,000 acre-feet of recoverable storage to the reservoir's capacity. Average return flow was only about 70 percent of the estimated maximum values computed in the earlier, steady-state analysis. Monthly ground-water outflow from the reservoir to the aquifer ranged from 55,200 to -10,400 acre-feet. Parameters tested for sensitivity, in order of decreasing sensitivity, were: Hydraulic conductivity, specific yield, hydraulic connection between

reservoir and aquifer, local recharge, boundary conditions, and dam permeability. The probable error in the parameters tested would not seem to warrant significant new data collection. (USGS)
W82-04725

DETERMINATION OF EFFECTIVE WELL BLOCK RADII FOR NUMERICAL RESERVOIR SIMULATIONS,
Systems, Science and Software, LaJolla, CA.
J. W. Pritchett, and S. K. Garg.
Water Resources Research, Vol 16, No 4, p 665-674, August, 1980. 7 Fig, 6 Tab, 6 Ref.

Descriptors: *Wells, *Reservoirs, *Simulation, *Numerical analysis, Mathematical equations, Model studies, Underground reservoirs, *Groundwater movement.

When using a numerical simulator to model underground reservoir behavior, it is often necessary to use well blocks, which are grid blocks containing a well, with dimensions much larger than the well diameter. Practical procedures have been developed for making reasonable estimates of well bore sandface conditions from the well block conditions calculated by numerical reservoir simulations. Assuming that pressures will equilibrate much more rapidly on a subgrid scale than in the reservoir as a whole, the subgrid flow may be treated as steady flow. The conditions at the sandface may then be deduced from mean well block conditions by assuming that the latter obtain at a definite distance, defined as the 'effective well block radius', from the well. However, the value of this effective well block radius must be established in terms of the size of the well block and other relevant parameters. Examination of the grid pressures obtained in the numerical solution of liquid flow into a single well located in both radial and rectangular grid blocks showed that the effective well block radius depends on the shape of the grid block (radial or rectangular), the type of mesh (uniform or otherwise), and the character of the spatial discretization scheme, among others. (Carroll-FRC)
W82-04732

INPUT-OUTPUT AND BENEFIT-COST ANALYSIS FOR WATER RESOURCE DEVELOPMENT PROJECTS,
Science and Education Administration, Lincoln, NE.
R. T. Clark.
Water Resources Bulletin, Vol 16, No 1, p 36-40, February, 1980. 9 Ref.

Descriptors: *Water resources development, *Cost-benefit analysis, Regional development, Resources development, Urban planning, Planning, *Input-output analysis.

The purpose of this research was to aid the use of input-output (I-O) in conjunction with benefit-cost (B-C) analysis for water resource development type projects. Terminological differences and differences due to benefit measuring methods are discussed. Proper use of the I-O model for estimating the secondary methods are discussed. Proper use of the I-O model for estimating the secondary effects depends in part on how the project benefits were valued, whether project outputs were sold to final or intermediate demand, and whether project output is represented by an endogenous sector. The analyst must look to the total effects on household income to determine secondary effects for B-C. Consequently, I-O models closed to households are more helpful than those that are open. Access to only final demand multipliers will limit the usefulness of I-O for estimating secondary benefits and costs, since final demand multipliers measure gross output changes instead of household income changes. Even income multipliers are not as helpful as the entire I-O model. There are many issues related to proper use of the I-O model that depend on the analyst's knowledge of I-O techniques and knowledge of how a specific model was developed. A result is that even though I-O can be helpful it can also be rather easily misused and can, therefore, provide misleading information. (Baker-FRC)
W82-04733

DEMAND SIGNALS FOR URBAN DRAINAGE AND FLOOD CONTROL PROJECTS,
North Carolina Water Resources Research Inst., Raleigh.
N. S. Grigg, and H. A. Vance.
Water Resources Bulletin, Vol 16, No 1, p 69-71, February, 1980. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Urban drainage, *Planning, *Economic aspects, *Flood control, Public opinion.

A new method is presented for determining the demand for urban drainage and flood control projects and to show how it can be used as part of an integrated planning procedure for setting priorities and allocating funds to competing projects. The method was devised by the Los Angeles County Flood Control District. The basic objective of the plan is to develop a logical rational planning procedure that will consider public demand for projects and allow planning to take place in the open. This ensures that opposition will be identified and dealt with early in the planning process and that surprises will be minimized. Results should yield a better utilization of the public funds both for planning and for implementation. The BENEVAL equation as developed represents a major step, as it is a surrogate measure of the public perception of the value of projects. It allows both screening for projects whose further development should be considered based on economic justification and prioritizing to allow greatest attention to those projects which are most urgent. (Baker-FRC)
W82-04737

6B. Evaluation Process

AUBURN DAM: A CASE STUDY OF WATER POLICY AND ECONOMICS,
Montana Univ., Missoula. Dept. of Economics.
J. W. Duffield.
Water Resources Bulletin, Vol 16, No 2, p 226-234, April, 1980. 4 Tab, 39 Ref.

Descriptors: *Cost-benefit analysis, *Water policy, *Economic analysis, Benefits, *Dams, *Auburn Dam, American River, *Sacramento, California, Water resources development, Earthquakes, Recreation, Irrigation, Dam failure.

This paper critically analyzes the economic justification of the Auburn Dam, part of the $1.5 billion Auburn-Folsom south unit of the Bureau of Reclamation's Central Valley Project in California. Construction on this dam has been stopped because the high thin arch structure, located on a major geological fault, is being recesigned for greater earthquake resistance. Errors in previous benefit-cost estimates were large. Irrigation benefits were overestimated and recreational losses underestimated. Revised benefit-cost ratios are 0.61 at 3 and 1/8% discount rate and 0.18 at 6 and 5/8% discount rate. Original estimates were 1.72 and 0.79 at the respective discount rates and failed to consider the cost of the permanent inundation of 48 miles of the American River Canyon or a probability-weighted estimate of catastrophic earthquake loss (much of metropolitan Sacramento would be inundated). This paper recommends that the project should not be continued. Suggestions for improving benefit estimation are: (1) use several approaches, (2) give priority to direct evidence of willingness to pay, as in market prices, (3) perform a site-specific analysis if results are sensitive to changes in average national numbers parameters, and (4) do not ignore destruction of natural environments such as wild rivers. (Cassar-FRC)
W82-04260

EVALUATING DIRECT BENEFIT ESTIMATION PROCEDURES FOR IRRIGATION PROJECTS: A SIMPLIFIED APPROACH,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
D. C. Cory, and J. Daubert.
Water Resources Bulletin, Vol 17, No 6, p 1066-1070, December, 1981. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Benefits, *Cost-benefit analysis, *Irrigation programs, Agriculture, Corn, *Nebraska, Economic analysis, Error analysis, Irrigation efficiency.

Commonly used methods for estimating direct benefits from irrigation are compared with a new method which estimates the sum of the changes in producers' and consumers' surplus. Errors inherent in the traditional methods are computed. Traditional methods measure impacts on the commodity markets by assuming the supply is inelastic. They either assume no change in commodity prices and calculate net returns to project farmers or allow commodity prices to fall in accordance with a given elasticity of demand and subtract commodity production costs from the associated area under the commodity demand curve. The new approach is used to evaluate 3 similar irrigation projects in Nebraska. Errors in benefits were 2% for the smallest project (10,000 acres of corn), and 8% and 15% for the larger projects (44,000 and 77,000 acres), respectively. (Cassar-FRC)
W82-04287

ENVIRONMENTAL THRESHOLD FUNCTIONS FOR USER ORIENTED RESOURCE PLANNING AND MANAGEMENT,
Illinois Univ. at Chicago Circle. School of Urban Sciences.
J. S. DeBettencourt, and G. L. Peterson.
Water Resources Bulletin, Vol 17, No 6, p 1050-1055, December, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Management planning, *Recreation, *Evaluation, Planning, Rivers, Surveys, Model studies, *Recreation facilities, *Site selection.

A method for assessing and measuring recreational site quality, called environmental threshold modeling, is described. It is based on the idea that persons using the recreation facilities have specific identifiable criteria which can be expressed as a mathematical function of site characteristics. The function separates acceptable recreational settings from unacceptable settings, hence the term, threshold function. The individual specific threshold functions can be combined to produce a population specific threshold function that gives the proportion of the population that finds a particular setting acceptable for a specific activity. Canoeists using the Pine River in Michigan's Manistee National Forest were asked to state whether or not each of 15 randomly generated combinations of characteristics would be acceptable for recreational canoeing. The characteristics were four levels each of water condition (pure to undesirable), degree of development (wilderness to urban), crowding/use (no other users to large number of users), trash/litter (none to heavy), and skill level required for canoeing (expert to beginner). The equation predicted that 80% of those surveyed would find characteristics of the Pine River site acceptable for use. If littering and crowding were reduced, the proportion of the population finding the conditions acceptable would rise to 93%. (Cassar-FRC)
W82-04289

FLOOD PROBABILITY ESTIMATION,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
S. O. Russel.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 63-73, January, 1982. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Flood forecasting, *Design floods, *Estimating, Hydrologic data, Flood data, Flood frequency, Susquehanna River, Carpenter Creek, British Columbia, Streamflow, Flood peak, Numerical analysis, Computer programs.

A procedure is presented for estimating design floods from the many types of hydrologic information available, even though there is not sufficient data for conventional frequency analysis. A compound distribution is used, and parameters of the underlying distribution are updated using Bayes' theorem. This permits subjective information to be combined with recorded data. The subjective information, not generally usable for traditional frequency analysis, may include a few recorded

floods, memory of bridges not being overtopped, evidence of a very large flood, envelope curves for the area, and river cross-sections. Numerical methods are used because analytical procedures are too limited. A computer program is used for calculations. Examples are given for a hypothetical case and for Carpenter Creek, British Columbia, and the Susquehanna River. The sparser and more uncertain the available data, the more conservative the results. (Cassar-FRC)
W82-04318

SMALL HYDRO SCHEMES FOR PRIVATE DEVELOPERS,
Hydro Watts Inc., Washington Grove, MD.
For primary bibliographic entry see Field 8A.
W82-04327

REGULATING CORROSIVE WATER,
Environmental Protection Agency, Washington, DC.
R. Anderson, and D. Berry.
Water Resources Research, Vol 17, No 6, p 1571-1577, December, 1981. 5 Tab, 22 Ref.

Descriptors: *Cost-benefit analysis, *Corrosion control, *Public health, *Water treatment, Benefits, Drinking water, Regulations, Lead, Toxicity, Cadmium, Asbestos, Water softening, Diseases, Lime, Economic analysis.

The benefit-cost relationships of an EPA proposal to regulate the corrosivity of drinking water are examined. Corrosivity may result from low pH, low buffering capacity, presence of dissolved oxygen, high total dissolved solids, high halogen and sulfate/alkalinity ratio, and high temperature. The major health effects of corrosive water are lead toxicity, increased incidence of hypertension and cardiovascular disease produced by cadmium, and the possibility of cancer from ingestion of asbestos fibers. Possible benefits of reducing corrosivity are less health risk, fewer operations and maintenance problems, and improved esthetics (reduction of discolored water and stained fixtures). Negative effects of increasing the water hardness to reduce corrosivity are negligible. Evidence indicates that water treatment to reduce corrosivity is warranted, especially for larger systems. Costs per life saved vary from $1720 (145 lives saved per year) in a 100 mgd plant serving 1 million people to $114,000 (0.0036 lives saved per year) in a 2500 gpd plant serving 2500 people. Annual per capita costs for lime treatment of soft water range from 25 cents for the 100 mgd plant to $16.40 for the 2500 gpd plant. This study illustrates the uncertainties involved in placing an economic value on benefits from reduction in incidence of diseases. (Cassar-FRC)
W82-04335

ENERGY, WATER, AND COST TRADE-OFFS IN IRRIGATION SYSTEM SELECTION AND MANAGEMENT,
California Univ., Davis.
For primary bibliographic entry see Field 3F.
W82-04360

GRANULAR ACTIVATED CARBON INSTALLATIONS,
Culp/Wesner/Culp, Cameron Park, CA.
For primary bibliographic entry see Field 5F.
W82-04391

THE REPRESENTATION OF VARIABLE HYDRO POTENTIAL IN LONG-RANGE ELECTRICITY PLANNING MODELS,
Victoria Univ., Wellington (New Zealand). Dept. of Information Science.
For primary bibliographic entry see Field 6A.
W82-04474

DEVELOPMENT OF HYDRO-POWER IN NIGERIA,
Benin Univ. (Nigeria). Dept. of Physics.
V. C. Sharma, and A. Sharma.
Energy, Vol 6, No 6, p 475-478, 1981. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Hydroelectric power, Prediction, *Nigeria, *Developing countries, *Costs, Water demand, Water use, Interest rates, Project benefits, Energy conservation.

Nigeria has a hydropower potential of 9500 MW, including 1300 MW from 21 minor sites. Only 8% of this or 800 MW has been developed. Early development of hydropower will not only reduce the burden on Nigeria's crude oil supply, but will also have an impact on agriculture, fish industry, fresh water supply, navigation and employment. The rate of hydropower development is heavily dependent on international loans from industrialized nations. Total hydropower generating capacities in 1985 and 1995 are expected to be 3245 and 4895 MW, respectively, reaching 8185 MW by 2000. (Cassar-FRC)
W82-04475

REVERSING WATER POLLUTION STANDARDS IN AN UNCERTAIN WORLD,
Geological Survey, Reston, VA.
W. D. Watson, and R. G. Ridker.
Land Economics, Vol 57, No 4, p 485-506, November, 1981. 4 Fig, 6 Tab, 14 Ref.

Descriptors: *Decision making, *Water pollution control, *Water quality standards, Planning, Nonpoint pollution sources, Water pollution sources, Regulations, Legal aspects, *Cost-benefit analysis, Benefits.

The overall results of a decision analysis of EPA's water pollution control policies indicate that lower costs for implementing these controls would be incurred if significant amounts of additional information were gathered and decisions changed accordingly. Little concrete information is available concerning the contribution of nonpoint pollution sources to water quality degradation. There is a possibility that more pollution control at lesser cost could be attained by reducing nonpoint source pollution than by upgrading point source treatment systems. Two cases were assumed: (1) EPA is attempting to minimize expected costs and (2) EPA is establishing controls to achieve fishable and swimmable water quality. The expected cost savings provided by additional information are $400 million per year at present, rising to $2 billion per year in Case (1) and $1 billion per year in Case (2) by 2010. These estimates are considered conservative. (Cassar-FRC)
W82-04540

WHO WINS IN THE FIGHT FOR POLLUTION CONTROL,
J. Donnan.
Water and Pollution Control, Vol 119, No 11, p 9-10, 12, 1981.

Descriptors: *Benefits, *Environmental quality, *Industrial wastes, Economic aspects, *Water pollution control, Water pollution prevention, Cost-benefit analysis, Social aspects, Regulations, Environmental policy, Public health, *Canada, Waste treatment.

Pollution control efforts must be directed toward the opportunities and benefits that can be attained. Economic studies have indicated that pollution control expenditures by industry are small relative to other expenditure categories and investments. The adverse effects on inflation and economic growth are insignificant. It has been more effective to apply pollution control technologies and waste prevention early in an industrial process than to treat waste products at the end. The 3M company has saved $17.4 million in this way over 3 years. For example, in one installation ppainting equipment designed to avoid overspraying cost $45,000 and saved the plant $120,000 per year in resin and paint costs. Tightening flanges at a Union Carbide plant saved $2,000 per day in raw material costs. Other possibilities for combined pollution and cost reduction are avoiding spills, reclaiming materials (such as wood fibers in paper mills), running a clean and tidy operation, using low sulfur fuels, changing a process to a less polluting one (producing chlorine for pulp bleaching by a mercury free process), producing saleable products from waste materials (suluric acid from SO2), and early environmental assessments in the planning or new plant construction. The public benefits of pollution control include reductions in pollution damage and increased enjoyment of a cleaner environment. Pollution costs are borne by a small, easily identifiable segment of society; benefits are spread over a large, less easily identifiable group. (Cassar-FRC)
W82-04554

CONTROL AND AUTOMATION IN WASTEWATER TREATMENT - ADVANCES, UNSOLVED PROBLEMS AND CHALLENGES,
For primary bibliographic entry see Field 5D.
W82-04597

CLEAN WATER FOR THE THIRD WORLD,
Biswas and Associates, Oxford (England).
For primary bibliographic entry see Field 6D.
W82-04604

THE RELATIONSHIP OF ACCESSIBLE SAFE WATER AND ADEQUATE SANITATION TO MATERNAL AND CHILD HEALTH--LOOKING FORWARD TO THE DRINKING WATER AND SANITATION DECADE,
Water and Sanitation for Health Project, Washington, DC.
For primary bibliographic entry see Field 6D.
W82-04606

THE FINANCING OF PRIVATE SMALL SCALE HYDROELECTRIC PROJECTS.
Franklin Pierce Law Inst. Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/CE/04934-44, Price codes: A06 in paper copy, A01 in microfiche. Department of Energy DOE/CE/04934-44, March, 1981. 106 p, 17 Tab, 1 Append. AS02-78RA04934.

Descriptors: *Hydroelectric plants, *Financing, *Economic feasibility, *Loans, Government finance, Costs, Marketing, Economic aspects, Regulations.

As a result of legislative and regulatory improvements, small scale hydroelectric (SSH) development is viewed as a potentially profitable enterprise. However, the lack of recent models for the development of SSH projects causes problems in the financing of these projects. A lack of developer information and a lack of lender information can combine to make it difficult to obtain funds necessary for the development of projects characterized by relatively large fixed costs, and whose only underlying security is the value of the power output. This manual is a description of the financing process associated with the private development of SSH projects, and is intended to provide the developer with some assistance in meeting the challenge of deciding how to proceed with the critical task of arranging the financing of his project. In any business venture, the business plan is a crucial guide for both internal and external financing decisions. The financing of SSH projects differs from most small business loans in that a SSH project usually requires an exceptionally large ratio of debt to equity, has an unusual marketing structure and is exposed to a pervasive regulatory scheme. A business plan should address the variables affecting the size, structure and cash flow and show how they would affect the project. The three business forms considered are corporations, Subchapter S corporations, and partnerships. Sources of funds which should be considered: commercial banks and savings and loan associations; manufacturers of hydroelectric equipment; investment bankers; state and municipal industrial development authorities; and federal financing assistance. (Moore-SRC)
W82-04633

A MANUAL FOR DEVELOPMENT OF SMALL SCALE HYDROELECTRIC PROJECTS BY PUBLIC ENTITIES.
Energy Law Institute, Franklin Pierce Law Inst. Center, Concord, NH.

For primary bibliographic entry see Field 6E.
W82-04634

ENERGY TECHNOLOGY SCENARIOS FOR USE IN WATER RESOURCES ASSESSMENTS UNDER SECTION 13A OF THE FEDERAL NONNUCLEAR ENERGY RESEARCH AND DEVELOPMENT ACT.
Department of Energy, Washington, DC. Office of Environmental Assessments.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0090, Price codes: A09 in paper copy, A01 in microfiche. DOE/EV-0090, October, 1980. 185 p, 6 Fig, 7 Tab, 17 Ref, 6 Append.

Descriptors: *Energy, *Fuel, *Water resources development, *Prices, *Hydroelectric power, *Geothermal power, Economic aspects, Forecasting, Future planning, Economic aspects, Pumped storage, Resources development, River basin development, Technology.

Two estimates of future growth of emerging energy technology in the years 1985, 1990, and 2000 were developed to be used as a basis for conducting Water Resources Council assessments. The two scenarios are called the high world oil price (HWOP) and low world oil price (LWOP) cases. The scenarios were generally derived from assumptions of he Second National Energy Plan (NEP II), including estimates of high and low world oil price cases growth rate of GNP, and related economic parameters. The overall national energy growth inherent in these assumptions was expressed as a detailed projection of various energy fuel cycles through use of the Fossil-2 model and regionalized through use of the strategic Environmental Assessment System (SEAS). These scenarios are for the use of regional analysis in examining the availability of water for and the potential impacts of future growth of emerging energy technology in selected river basins. The energy scenarios provide projections for the following categories of emerging energy technology: coal gasification; coal liquefaction; oil shale; geothermal; enhanced oil recovery; solar and biomass; small scale, low head, and pumped storage hydroelectric; and advanced coal combustion. (Moore-SRC)
W82-04635

DETERMINING FEASIBILITY OF SMALL-SCALE HYDROPOWER,
Tudor Engineering Co., San Francisco, CA.
D. C. Willer.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 209-217, December, 1981. 4 Fig, 4 Tab, 3 Ref.

Descriptors: *Hydroelectric plants, *Cost-benefit analysis, *Feasibility studies, Hydraulic structures, Benefits, Dams, Powerplants, Energy, Economic analysis, Capital costs, Rate of return, Discount rates, Small-scale hydropower.

Techniques for evaluating the economic feasibility of small hydropower projects are presented and illustrated with examples. The simplest is the benefit-cost analysis, which compares annualized capital, operating, maintenance, and administration costs with the value of power produced. Another method is that using the internal rate of return, the discount rate where the benefit-cost ratio equals 1.0. It is computed by plotting several benefit-cost ratios vs. discount rates. A third technique is the discount cash flow analysis, which uses different escalation and discount rates to provide a variety of benefit-cost streams. The present worths of the benefit-cost streams are then assumed and a ratio computed. A further consideration is the primary energy factor, the energy required to manufacture and construct a hydro project. (Cassar-FRC)
W82-04693

INPUT-OUTPUT AND BENEFIT-COST ANALYSIS FOR WATER RESOURCE DEVELOPMENT PROJECTS,
Science and Education Administration, Lincoln, NE.

For primary bibliographic entry see Field 6A.
W82-04733

A MUNICIPAL WATER SUPPLY INVESTMENT PROBLEM IN RHODE-ISLAND,
Western Washington Univ., Bellingham. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W82-04740

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER QUALITY ALLOCATED COST FOR MULTIPURPOSE RESERVOIRS,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Water Resources Bulletin, Vol 16, No 1, p 127-132, February, 1980. 7 Tab, 5 Ref.

Descriptors: *Water quality, *Cost allocation, Reservoirs, Cost sharing, Economic aspects, Cost analysis, Low flow, Water management, Wastewater treatment, Flow augmentation, *Multipurpose reservoirs, *Model studies, *Willamette River, Oregon.

Apportionment of reservoir costs may be appropriate to downstream waste water dischargers who by virtue of reservoir drawdown may be saved the expense of advanced secondary of tertiary waste treatment. Low flow augmentation from multipurpose reservoirs may yield significant water quality benefits. By using cost allocation, a portion of reservoir expense is assigned to water quality consumers, waste water dischargers who benefit from the increased receiving flow. Federal projects do not authorize such allocation. However, the procedure is increasingly appropriate for efficient multiobjective management. A model was constructed for waste water treatment costs, multipurpose reservoir costs, and water quality for Oregon's Willamette River. Water quality is expressed as a function of treatment and augmentation levels. Treatment cost needed to achieve a given quality of water without augmentation less treatment cost with augmentation gives an alternative cost of maintaining water quality. This alternative cost is used to determine water quality's share of reservoir cost via a cost allocation procedure. Water quality beneficiaries could be charged, under current conditions, about 7% of annualized reservoir expense. This charge is one-fourth of the expense of additional treatment facilities required if augmentation were not provided. (Baker-FRC)
W82-04255

CONSERVING WATER THROUGH PRICING,
State Univ. of New York at Albany.
For primary bibliographic entry see Field 3D.
W82-04272

MARGINAL COST AND SEASONAL PRICING OF WATER SERVICE,
West Virginia Univ., Morgantown. Regional Research Inst.
P. C. Mann, and D. L. Schlenger.
Journal of the American Water Works Association, Vol 74, No 1, p 6-11, January, 1981. 7 Ref.

Descriptors: *Water rates, *Marginal costs, *Seasonal variation, Pricing, Costs, Water demand.

Seasonal pricing is not synonymous with marginal cost pricing, although it is a logical consequence of the latter. Effective seasonal pricing requires that several criteria be fulfilled. There must be substantial variations in demand between peak and off-peak periods. Installed capacity requirement must be determined primarily by the peak demands of the specific system. The water utility must have peak demands which consistently occur during the same periods of the year, and the water utility must be able to estimate the difference in cost between meeting peak and off-peak demands. Several application problems can impede the use of seasonal pricing: cost calculation problems, prediction problems, excess revenue problems, income distribution and efficiency problems, needle peaking, shifting peaks, public acceptance, and metering difficulties. Systematic consideration of these problems is necessary for successful implementation of innovative pricing plans. They should not be regarded as barriers to reform in rate structures. (Carroll-FRC)
W82-04273

ON THE MARGINAL COST OF WASTEWATER SERVICES,
President's Council of Economic Advisers, Washington, DC.
S. H. Hanke, and R. W. Wentworth.
Land Economics, Vol 57, No 4, p 558-567, November, 1981. 3 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Pricing, *Marginal costs, Economic aspects, *Operating costs, Capital costs, Cost analysis, Economies of scale, Opportunity costs, Tariff.

The marginal cost of municipal wastewater services is analyzed for the purposes of designing a tariff for these services. In this paper marginal cost of wastwater services is defined so that the opportunity cost may be measured. The marginal cost is estimated for a hypothetical wastewater system, capacity 570,000 cu m per day, using the activated sludge process to serve a community of 300,000. In 1979 the total marginal cost for this system was 57 cents per cu m per year (54 cents major capital costs and 3 cents running costs). A two-part tariff is the most efficient and sound. Part 1 is the price per composite unit of use (57 cents in the above example) and part 2, the annual standing charge per customer (equal to the total cost of system overheads not directly related to use, but necessary to guarantee system maintenance over time). The overheads may include costs of meters, billing expenses, and connection costs. (Cassar-FRC)
W82-04376

COSTING DAR-ES-SALAAM'S SANITATION PLAN,
Peat, Marwick and Co., London (England).
M. Hoyle, and R. Eadie.
World Water, Vol 4, No 12, p 30-31, December, 1981.

Descriptors: *Waste disposal, *Domestic wastes, *Urban areas, *Costs, Sewer systems, Sanitation, Public health, Housing, *Tanzania, Urban hydrology, Land disposal, *Developing countries.

Since two-thirds of the householders of Dar-esSalaam, Tanzania have low incomes and are unable to pay for high-priced sanitation systems, a new master-plan for low cost sewage disposal was drawn up from data on water consumption, plumbing facilities and income levels to accomodate the new housing developments with sanitary sewage disposal systems. The first stage of the plan, which will take from 1981-85 to complete, calls for the installation of improved pit latrines in most housing units, the implementation of a community health education program, and a rehabilitation and expansion of the pit emptying service. Funds for this stage will come from City Council, the World Bank, and other government aid agencies. Direct educational assistance will be given to households needing to install new latrines, while the cost of constructing and emptying the pit latrine will be borne directly by the owner of the house. The total cost for construction and maintenance of the pit latrine should account for no more than about 1.5% of total family income. The extension of the pit installation service should be funded out of general taxation because the annual user per capita costs are small and the direct beneficiaries of such a service are not identifiable. An Urban House Tax based upon the type of latrine present would be charged as a simple flat rate to each household. At present, pit emptying is carried out by the City Council and a number of independent operators who receive full payment when services are rendered or collect payments over the course of set periods by a more easily payable installment plan. (Geiger-FRC)
W82-04603

FINANCING FEDERAL WATER DEVELOPMENT PROJECTS AND SHARING THE COSTS,
Water Resources Council, Washington, DC.
R. M. Wheeler, L. M. Eisel, and G. D. Seinwill.
Water Resources Bulletin, Vol 16, No 2, p 326-335, April, 1980. 5 Fig, 20 Ref.

Descriptors: *Financing, *Water supply development, *Cost sharing, Water management, Planning, Administration, Political aspects, *Federal jurisdiction, Economic aspects.

A brief survey is presented of past and present Federal involvement in water resources development, along with a closer look at the nature of cost sharing and an assessment of the varied assortment of existing Federal and non-Federal cost sharing provisions. Samplings of some relevant emerging issues are presented, with the focus on policy questions that are currently arising due to competing interests for water and water project funding. Several proposed strategies for dealing with cost sharing policy reform are discussed, with detailed emphasis on two current proposals under consideration. The joint venture approach results in an effective composite cost share which changes significantly but not drastically, from 19 to 35% non-Federal share for a hypothetical project. The block grant approach would alter the regional distribution of Federal water development funding from the South and West to the Northwest and North Central States. To be successful any strategy not only must be theoretically sound, but must be politically sound as well. Practical solutions must be sought through the existing political structure, as any realistic solution generally requires the transfer of a subsidy from one interest to another. (Baker-FRC)
W82-04739

THIRD-DEGREE PRICE DISCRIMINATION AND REGULATION IN THE MUNICIPAL WATER INDUSTRY,
Lafayette Coll., Easton, PA.
T. H. Bruggink.
Land Economics, Vol 58, No 1, p 86-95, February, 1982. 5 Tab, 17 Ref.

Descriptors: *Pricing, *Water rates, Regulations, Economic aspects, Water demand, Water supply, *Price discrimination.

This paper discusses the practice of third-degree price discrimination and the role of state regulation in governing rate structures as they concern the structuring of rates for municipally owned water utilities. The conclusions suggest that third-degree price discrimination is practiced by municipally owned water utilities. The average pice-marginal cost ratios for the residential, commercial, and industrial customer classes are 3.45, 2.32, and 1.52, respectively in the unregulated utilities, and 3.12, 1.81, and 1.04 in the regulated utilities. The differences are excessively large, with the industrial customers clearly identified as the benefited group. There is no evidence of internal subsidization across the customer classes. However, the excessive price discrimination is undesirable under the criteria suggested by Hollas and Friedland. Also noted are sharp reductions in the price-cost ratios for all customer classes in utilities regulated at the state level. The reductions are uneven, however, with the industrial and commercial customer classes receiving larger absolute and percentage reductions than the residential class. In regulated, municipally owned electric utilities the industrial customers had the lowest price-cost ratios. (Baker-FRC)
W82-04747

6D. Water Demand

DETERMINISTIC MODELS FOR PREDICTING RESIDENTIAL WATER CONSUMPTION,
Department of Transport and Works, Darwin (Australia).
N. A. Power, R. E. Volker, and K. P. Stark.
Water Resources Bulletin, Vol 17, No 6, p 1042-1049, December, 1981. 5 Fig, 4 Tab, 8 Ref.

Descriptors: *Water consumption, *Lawns, *Domestic water, *Model studies, Water demand, *Residential water, *Water use, Irrigation, Townsville, Australia.

Two deterministic models for forecasting residential water demand are presented. Lawn water requirements and in-house use are considered separately, then combined for a total predicted consumption. The in-house model requires the residence population, appliance ownership per residence, and water consumption of an appliance per use. It can simulate effects of changes in appliance ownership patterns, population distribution, appliance unit water use, and frequency of use. The lawn water model is a daily water balance model with a single soil moisture store. It operates in two phases, a drying phase through evaporation and transpiration and a wetting phase through rainfall and irrigation. Residential water consumption in Townsville, Australia, was modeled after a survey of a random sample of residences. In-house model results were 197 liters per capita per day; 205 liters per capita per day was obtained by measuring sewage flows. Simulations showed that increases of 100% in dishwasher ownership and garbage disposal ownership would increase average in-house consumption by 5.2% and 3.4%, respectively. Lawn water consumption was measured at five metered homes for 12 months. Simulated and actual water applied agreed within about 6 mm in the range of 669-885 mm seasonal irrigation water depths. (Cassar-FRC)
W82-04352

WATER RIGHTS, ALLOCATION, AND CONFLICTS IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
For primary bibliographic entry see Field 6E.
W82-04441

AN ECONOMIST'S VIEW OF DEMAND PROJECTIONS CONSIDERING CONSERVATION,
California Univ., Santa Barbara. Dept. of Economics.
W. D. Morgan.
Water Resources Bulletin, Vol 16, No 5, p 941-943, October, 1980. 2 Fig, 6 Ref.

Descriptors: *Water demand, *Water conservation, *Water use, *Economic aspects, Prices, Water management, Water supply, Mathematical studies, Elasticity of demand.

An approach was developed to clarify and elaborate on procedures for measuring water use undder alternative conservation specifications. An attempt was made to place the analyses in terms of traditional economic analysis. Using this analysis, the effects of conservation can be divided into two classes, pure conservation effects and pure demand management. The use of demand management to reduce quantity demanded operates through an increase in the price of water, which means individuals move up their demand curve and choose a smaller quantity. Conservation policies incorporate other factors that affect water usage, while holding the price constant. An increase in the conservation percentage reduces the quantity of water demanded. Providing information on techniques or technology is very important to enable users to choose the proper amount of water needed to meet their specified goals. Some instruments to meet these goals are under the control of the water agency, while others are not. However, the variable price is always under the control of the water purveyors. (Baker-FRC)
W82-04448

GROUND-WATER CONDITIONS IN THE UPPER VIRGIN RIVER AND KANAB CREEK BASINS AREA, UTAH, WITH EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. M. Cordova.
Available from Utah Dept. of Natural Res. Div. of Water Rights 231 East 400 South Salt Lake City, Utah 84111. Utah Department of Natural Resources Technical Publication No 70, 1981. 87 p, 18 Fig, 3 Plates, 23 Tab, 30 Ref.

Descriptors: *Groundwater, *Aquifer characteristics, *Water quality, *Well yield, Well data, Pumping, Drawdown, Groundwater recharge, Water level fluctuations, Surface-groundwater relations, Groundwater availability, Water supply, Water demand, Chemical analysis, Maps, *Utah, Virgin River basin, Kanab River basin, Navajo Sandstone.

The upper Virgin River and Kanab Creek basins area in south-central Utah includes about 1,300 square miles in the upper Virgin River basin and about 650 square miles in the upper Kanab Creek basin. The sparsely populated area contains large coal reserves. Water occurs in both the unconsolidated and consolidated rocks. Principal aquifers in the unconsolidated rocks include older stream-channel deposits, lower parts of alluvial fans, and stream-valley alluvium. The most important consolidated-rock aquifer is the Navajo Sandstone of Triassic and Jurassic age. Other consolidated-rock aquifers of note include the Shinarump Member of the Chinle Formation of Triassic age, sandstone strata of Cretaceous age, and the Wasatch Formation of Tertiary age. Groundwater recharge is derived chiefly from precipitation on the area and is estimated to average about 80,000 acre-feet per year. Discharge occurs chiefly as seepage to lower stream reaches and evapotranspiration; natural discharge is estimated to total at least 62,700 acre-feet per year. In addition, about 5,000 acre-feet per year discharges as underflow into Arizona; and in 1977, at least 3,300 acre-feet was withdrawn by wells. Chemical quality of ground water varies considerably with geologic source. Water in the Navajo Sandstone and Wasatch Formation is generally fresh, containing less than 500 mg/L of dissolved solids in most places. Water in the Chinle and Moenkopi Formations of Triassic age and the Carmel Formation of Jurassic age is generally saline, containing 1,000 to 3,000 mg/L of dissolved solids in most places. (USGS)
W82-04486

WATER-QUALITY DATA FOR SELECTED STATIONS IN THE EAST EVERGLADES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04513

DIGITAL-MODEL SIMULATION OF THE TOPPENISH ALLUVIAL AQUIFER, YAKIMA INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2A.
W82-04514

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978.
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04518

CLEAN WATER FOR THE THIRD WORLD,
Biswas and Associates, Oxford (England).
A. K. Biswas.
Water Supply and Management, Vol 5, No 6, p 401-415, 1981. 12 Ref.

Descriptors: *Drinking water, *Public health, *Developing countries, United Nations, *Costs, International Drinking Water Supply and Sanitation Decade, Water resources development, Sanitation, World Health Organization, Education, Water supply, Water quality standards, Investment, Institutional constraints, Political constraints, Reviews.

Current information on the availability and use of potable water in developing countries is critically

reviewed. Weaknesses in the World Health surveys of 1962, 1970, and 1975 are incomplete information (China and several other countries were not included), countries overestimating or underestimating the status of clean water supplies either to improve their images or to call attention to their difficulties, the intermittent nature of water service in may locations, and differences in enumeration method among countries. Provision of clean water without concurrent improvements in sanitation and health education is very ineffective. Western world water quality standards cannot be imposed on developing countries because significant percentages of existing water suplies would be automatically condemned and cost of equipment and personnel to maintain these high standards would be impractically high. The goal should be a variable standard to suit the locale, people, infection risks, and finances. Many cost estimates for the Decade have been calculated and revised. The currently accepted cost is $300 billion, considered by many to be a serious underestimate. There is small chance that the Decade will meet its goals. Constraints that must be overcome to ensure success are the lack of funds in the developing countries, the priorities of the individual countries, the lack of institutional infrastructure in many areas, lack of trained manpower, and lack of understanding of local conditions. (Cassar-FRC)
W82-04604

TRANSGLOBAL VARIATIONS IN THE PLANNING OBJECTIVES AND CRITIQUES,
Ministry of Water and Power, Islamabad (Pakistan).
For primary bibliographic entry see Field 6A.
W82-04605

THE RELATIONSHIP OF ACCESSIBLE SAFE WATER AND ADEQUATE SANITATION TO MATERNAL AND CHILD HEALTH--LOOKING FORWARD TO THE DRINKING WATER AND SANITATION DECADE,
Water and Sanitation for Health Project, Washington, DC.
R. B. Isely.
Water Supply and Management, Vol 5, No 6, p 417-424, 1981. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Drinking water, *Public health, *Social aspects, Sanitation, International Drinking Water and Sanitation Decade, Benefits, *Developing countries, United Nations, Diseases, Women, Children.

The chief beneficiaries of planned improvements in developing countries' water supplies and sanitation will be women and children. The average East African woman uses 9% of her daily caloric intake to obtain water for the household, up to 27% in hilly country. Diarrhea and its effects account for 30% of deaths in Third World children 0 to 4 years old. Waterborne diseases are responsible for undernutrition and many other ailments. Benefits from safe water supplies and improved sanitation are three fold: a better quality of life for women, reduced mortality and morbidity in young children, and the advantages that mother and child experience as a single bio-social unit (increased birthweight of infants, prolonged breastfeeding period, more time for child care, and a reduction in birth rate). (Cassar-FRC)
W82-04606

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: SEVIER LAKE BASIN, UTAH.
Federal Energy Regulatory Commission, San Francisco, CA. San Francisco Regional Office.
Appraisal Report, September, 1980. 61 p, 20 Fig, 10 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Water demand, *River basin development, Irrigation, Flood control, Precipitation, Runoff, *Sevier Lake basin, *Utah.

The Sevier Lake basin is a major land-locked drainage basin covering all or portions of 11 counties in southwest Utah and a small portion of one county in Nevada. Average annual precipitation ranges from about 8 inches in the western desert to over 30 inches in the mountains. In spite of groundwater tables, which tend to recharge the Sevier River, losses to evapotranspiration aided by irrigation deplete flows in the river to the extent that runoff reaches Sevier Lake only during rare high flows. Approximately 400,000 acres (less than 5% of the total basin area) are irrigated. Fourteen small operating hydroelectric powerplants in the basin have a combined installed capacity of 6,260 kw, of which 77% is under license. The basin's hydroelectric plants produce about 34 gigawatthours annually which is about 5% of the forecasted 1978 energy requirement. There are two flood control projects in the basin. About 38% of the basin's installed hydroelectric capacity is developed in the 2,400 kw Upper Beaver plant. The Upper Beaver plant is in good condition and capable of being operated efficiently for a number of years in the future. It is not considered to be economically justified for the company to make repairs for resumed power production at the Lower Beaver plant. Water resource projects which have been considered for development include: a land rehabilitation program; a water diversion project; two pumped storage projects, and two low-head hydroelectric powerplants. (Moore-SRC)
W82-04636

THE WELSH APPROACH TO WATER RECREATION,
S. Le Lievre.
Water, No 42, p 29-31, 1982. 3 Fig.

Descriptors: *Water use, *Recreation, *Water demand, Boating, Fishing, Lakes, Reservoirs, *Wales, Regulations.

The Welsh Water Authority Strategic Plan for Waterspace Recreation and Amenity was recently released. Representative bodies of users and individuals with interests in countryside conservation and wildlife protection have given unequivocal approval and support to the authority's proposals, which took six years to complete. Uppermost in the minds of the authority is the conservation of the countryside in which the visible assets of water space are located. Much of the time taken in preparing the master plan was occupied in consultations with all types of users, in order to search for practical solutions to possible areas of conflict or clashes of interest. (Baker-FRC)
W82-04658

THE SEVEN-TRENT STUDIES OF INDUSTRIAL WATER USE,
Severn-Trent Water Authority, Birmingham (England).
J. E. Thackray, and G. G. Archibald.
Proceedings of the Institution of Civil Engineers, Part 1: Design and Construction, Vol 70, No 2, p 403-434, August, 1981. 9 Fig, 22 Tab, 16 Ref.

Descriptors: *Water use, *Industrial water, Water consumption, *Water demand, *Municipal water, Water reuse, Wastewater disposal, Economic aspects, *Severn-Trent Water Authority, Water prices, *England.

An extensive investigation of industrial and commercial water usse in the Severn-Trent Water Authority region involved a detailed survey of water use practices and policies of 3000 metered consumers. The proportions of piped water and directly abstracted water used by different industries are reported. Average annual metered consumption in the region rose from 550 million/liters per day in 1965 to 625 million liters per day in 1970, declined sharply to 525 million liters per day in 1977, and increased slightly to 575 million liters per day in the late 1970's. A table of water use classified by 18 different processes (cooling, product rinsing, gas scrubbing, etc.) in 16 industry categories (mining, food, chemicals, etc.) is presented. Water use per employees in manufacturing industries averaged 2065 liters per day, with wide variations. Domestic type water use by persons at work in industry averaged 96 liters per person per day, slightly less than the average household per capita consumption, 115-120 liters per day. Other tables and figures concern water use per unit of manufacturing output, water charges as a percentage of total costs, water saving schemes used in industry, elasticity of demand with respect to output, water recycling, average water use in service industries, and disposal of used water. This information base is usable by those involved in economic appraisals and in forecasting and design of facilities for water suppliers and consumers. (Cassar-FRC)
W82-04686

MASSACHUSETTS WATER SUPPLY PRIORITIES,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
T. F. McLoughlin.
Journal of the New England Water Works Association, Vol 95, No 4, p 271-279, December, 1981. 2 Ref.

Descriptors: *Water supply, *Water resources development, *Massachusetts, *Water demand, Conservation, *Water quality, Industrial wastes, Aquifers, Financial aspects.

Water supply priorities are discussed, including impacts of hazardous waste on water supply, protection of existing and future aquifers, water conservation, regionalization, and budgetary constraints. Drinking water supplies in at least one-third of the communities in Massachusetts have been affected by organic chemical contamination to some degree, resulting in the closure of wells in 22 communities, with capacity losses averaging 40% and ranging as high as 100%. Increasing demands on groundwater supplies must be met with safeguards to protect the aquifers from further contamination. Fluctuations in groundwater levels are caused by a number of factors, including seasonal variations, changes in river and stream stages, various forms of withdrawal, and recharge. Tremendous efforts are underway to explore traditional and non-traditional sources of water supply. However, the need for conservation is clear. Water conservation programs can benefit water quality and quantity in various ways, including financial savings for the municipality as well as the individual homeowner. Regionalization is another name for sharing resources. This type of approach has great potential in solving supply and demand issues in the state of Massachusetts. Various factors to be considered include adequacy and reliability, quality, cost, legality and politics. (Baker-FRC)
W82-04698

A MULTIVARIATE ANALYSIS OF MUNICIPAL WATER USE IN UTAH,
Utah State Univ., Logan.
For primary bibliographic entry see Field 3D.
W82-04728

A METHOD FOR ESTIMATING PEAK WATER DEMAND OF MULTIFAMILY RESIDENCES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
B. Bobee, P. Boucher, and H. Demard.
Water Resources Bulletin, Vol 16, No 4, p 729-737, August, 1980. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Peak demand, *Domestic water, Apartments, *Water demand, *Statistical analysis, Water pressure.

Peak water demand for apartment residences of three or more units was estimated from the square root of the number of apartment units in the building and the cube root of water pressure. This relationship was obtained from statistical analysis of data from 17 apartment buildings, 3 to 41 apartments each, in Sainte-Foy, Quebec, using the Ridge-regression technique. The formula may be applied to the eastern U.S., where appliances, pressure conditions, and mean water demands are similar to those used in the study. Oversizing of meters and service lines increases maintenance costs, underregisters low demand, and requires a large initial investment. Undersizing the equipment leads to increases in friction loss, possible damage to the meter, and undercapacity. (Cassar-FRC)
W82-04734

A MUNICIPAL WATER SUPPLY INVESTMENT PROBLEM IN RHODE-ISLAND,
Western Washington Univ., Bellingham. Dept. of Economics.
R. Frye, and J. W. McFarland.
Water Resources Bulletin, Vol 16, No 1, p 31-35, February, 1980. 10 Ref.

Descriptors: *Water demand, *Water conservation, *Economic aspects, Computers, Water resources development, Resources development, *Rhode Island, Water supply, Water supply development, Water requirements, Model studies, Pricing.

Two approaches are considered to a residential water supply problem being experienced in Rhode Island. The first approach is a benefit maximization model incorporating price sensitive water demand as the basis for measuring system benefits. This is contrasted with a 'requirements' approach, which is a cost minimization model constrained b the requirement to provide a minimum quantity per household. To reconcile the differences between the results of the two approaches, a modification is made in the benefit-maximization approach to include peak demand considerations. The study focuses on Newport, Middletown, and Portsmouth, Rhode Island, located on Aquidneck Island in Narragansett Bay. Results indicate that a requirements approach can lead to findings similar to a benefit maximization model incorporating price sensitive demand. Incorporating price sensitive demand also leads to ambiguous results due to not knowing which demand function to use as a measure of benefits or how to construct such a function. The findings do confirm that dynamic programming is a useful way of formulating the intertemporal investment-production problem in different sources of supply and/or capital components exhibiting differing economies of scale. The method allows explicit consideration of the tradeoffs between the costs of periods of excess capacity and economies of scale for a number of components. The choice of an objective function requires flexibility; benefit maximization and cost minimization can lead to similar or dissimilar results, depending on the flexibility of the analyst and the model. (Baker-FRC)
W82-04740

6E. Water Law and Institutions

WATER MANAGEMENT IN ONTARIO,
Ontario Ministry of the Environment, Toronto.
S. E. Salbach, and R. P. Dennis.
Water Resources Bulletin, Vol 16, No 4, p 621-262, August, 1980.

Descriptors: *Water management, *Regulations, *Water policy, *Water quality standards, Management, *Ontario, Groundwater, Surface water, Effluent standards, Water allocation, Water pollution control.

The Ontario Ministry of the Environment revised its 1970 guidelines for water quality management in 1976 as a response to changes in the social and economic background, advances in technology, and philosophical attitudes toward water management. Goals, objectives, and policies to implement the goals are given for management of surface water quality and quantity and groundwater quality and quantity. For example, the goal for surface water quality is to ensure that the surface waters of the province are of a qality which is satisfactory for aquatic life and recreation. The policies for implementation concern areas with water quality better than the objectives, areas with water quality not meeting the objectives, effluent requirements, hazardous subsurfaces, and mixing zones. The revised approach involves imposition of legally enforceable effluent requirements on a case-by-case basis rather than having province-wide effluent standards. Five working groups are developing the necessary detailed implementation procedures. (Cassar-FRC)
W82-04259

OBJECTIVES AND CONSTRAINTS IN FEDERAL WATER RESOURCES PLANNING,
Policy Sciences Associates, Boulder, CO.
W. B. Lord.
Water Resources Bulletin, Vol 17, No 6, p 1060-1065, December, 1981. 6 Ref.

Descriptors: *Planning, *Decision making, *Political constraints, Water Resources Council, Water resources development, Economic development, Environmental quality, *Water policy, Public participation.

The Water Research Council's 1973 'Principles and Standards' states that plans should be formulated to reflect national, regional, state, and local needs or problems consistent with the objectives of improvements in national economic development and environmental quality. There is no specified approach to reconciling national objectives with local needs and problems. Increasingly, the approach has been to plan with national objectives as the first consideration. This is not the most practical or desirable method, partly because the national objectives are general and abstract. Many conflicts between the federal government and local groups have arisen over water resources development projects. A more satisfactory planning method is to formulate plans for solving a specific local problem and then consider the restraints imposed by the national objectives. Public participation on the local level is recommended. (Cassar-FRC)
W82-04288

THE ADOPTION OF MUNICIPAL WATER CONSERVATION: AN UNLIKELY EVENT,
Oklahoma State Univ. Stillwater. Dept. of Economics.
R. L. Moomaw, and L. Warner.
Water Resources Bulletin, Vol 17, No 6, p 1029-1034, December, 1981. 1 Tab, 11 Ref.

Descriptors: *Water conservation, *Institutional constraints, *Pricing, *Municipal water, Water rates, Planning, Nonstructural alternatives, Water policy, Profit, Political aspects.

Municipal water utilities are unlikely to voluntarily adopt water conservation practices which reduce net revenues, even if they are beneficial in the long term. Institutional changes are suggested. Decisions involving decreases of revenues (pure conservation measures such as new plumbing codes, education, and retrofitting) should be removed from the water enterprises jurisdiction. Subsidies to the water company for improved management practices such as meter repair and leak control may increase chances for adoption of these conservation measures, even though they decrease revenues. Conservation pricing (overall rate increase, summer surcharges, and flat rates) increase water company revenues but may create illegal or unpopular profits. Laws can be changed to allow use of such profits for property tax relief or other acceptable programs. A study of five Texas and Louisiana cities illustrates some of these alternatives. All these cities have had recent water increases of 10% to 35%, and all but one had sewer increases from 35% to 140%. There is also a trend toward conservation by better management and maintenance. Only one city adopted measures that cost the utilities money and decreased short-term revenues. (Cassar-FRC)
W82-04343

THREE IMPORTANT COURT DECISIONS,
Cook Coll., New Brunswick, NJ.
W. Goldfarb.
Water Resources Bulletin, Vol 17, No 6, p 1097-1098, December, 1981.

Descriptors: *Judicial decisions, *Landfills, *Effluent standards, Water law, *Water management, Chemical wastes, Waste disposal, Cost-benefit analysis, Permits, *Illinois.

Three court decisions of concern in water management are reported. In the Village of Wilsonville v. SCA Services, Inc., the Illinois Supreme Court affirmed a lower court decision to close a hazardous waste landfill located in a coal mine subsidence zone because it threatened groundwater quality. The argument that the landfill site and all disposals had state EPA approval were rejected because permits were allegedly based on inaccurate data. In Issac Walton League v. Marsh a federal court of appeals refused to review the cost-benefit analysis for the Army Corps of Engineers Locks and Dam 26 Project on the Mississippi River near Alton, Illinois, thus allowing the project to preceed as authorized. The American Paper Institute v. EPA case invalidated the Environmental Protection Agency regulations for industrial effluent discharges based on best conventional pollutant control technology (BCT). It is likely that little progress beyond Phase I, best practicable technology (BPT), will be seen in the near future. (Cassar-FRC)
W82-04349

THE WINTERS DECISION AND INDIAN WATER RIGHTS--A MYSTERY REEXAMINED,
California Univ., Los Angeles. Dept. of History.
N. Hundley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211525, Price codes: A03 in paper copy, A01 in microfiche. March, 1982. 31 p, 77 Fig. OWRT A-059-CAL(3).

Descriptors: *Legal aspects, *Water rights, *Judicial decisions, *History, *Indian reservations, Western United States, Semiarid lands.

Water is the natural resource of greatest concern in western American, an area of few rivers, sparse rainfall, and monumental struggles over the precious commodity. Joining increasingly in the struggles have been Native Americans, most of whose reservations and reservation population are found in the driest portions of the region. No less concerned are non-Indians whose cities, industries, and farms are already using most of the West's water. At the heart of these controversies, both past and in-th-making, are differences over a 1908 decision rendered by the United States Supreme Court in Winters v. United States. That decision announced for the first time the existence of an Indian water right, but the meaning of the court's action has become clouded in debate which has exacerbated conflicts between Indians and non-Indians and created a crisis of national significance. For more than half a century, attorneys, legal scholars, and historians have quarreled over the meaning to the Winters decision with three issues in particular dominating their differences: the quantum or volume of the Indian right, the legitimate uses to which the water guaranteed by the right can be put, and the priority of the right in relation to the rights of non-Indians desirous of the same water sources. Careful examination of published documents and heretofore overlooked manuscript materials helps to clarify the intentions of the Winters court and to shed light on the ongoing disputes over the Indian water right. (Snyder-California)
W82-04410

WATER RIGHTS, ALLOCATION, AND CONFLICTS IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
D. H. Kickox.
Water Resources Bulletin, Vol 16, No 5, p 797-803, October, 1980. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Water law, *Montana, *Water resources development, *Water rights, Water requirements, Legal aspects, Water use, Water policy, State jurisdiction, *Water demand, Water supply, Riparian rights, Reservoir storage, Irrigation requirements, Future planning, Coal, *Tongue River basin.

The extensive development of coal deposits in Southeastern Montana's Tongue River basin has created a great demand on the area's water resources. In some areas not enough water is available to meet demands, while in other cases, even though water is in abundance, it may not be legally available due to a new Montana water allocation system, Indian lawsuits, or state policy toward water resource development. Some energy proj-

ects threaten to dewater the river, degrade water quality and endanger aquatic ecosystems. The Montana Water Use Act was enacted in 1973 to end the uncertainties existing in Montana water law by requiring final allocation and adjudication of the state's waters. In 1974, the Water Moratorium Act was passed to allow the state time to plan for future water use. In 1978, plans were made for the Tongue River Reservoir, which will soon be replaced by a larger dam and reservoir. Irrigation districts will be allotted all the water they have requested. The Fish and Game Department has requested enough water to maintain instream flows. Processing of industrial applications for water began in 1979. The Montana Water Storage Company and the Water Reserve Company have both requested large diversions that cannot be met by the available water in the Tongue River. Industrial allotments will probably continue to take a second place to preferred agricultural water uses in Montana. (Geiger-FRC)
W82-04441

DEVELOPMENT OF FEDERAL RESERVE RIGHTS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
J. W. Bird.
Water Resources Bulletin, Vol 16, No 5, p 837-842, October, 1980.

Descriptors: *Federal jurisdiction, *Water rights, *Water law, *Arid zone hydrology, *Reservation doctrine, Flood control, Water management, Legal aspects, Riparian rights, Water policy, Water supply, Water use, Navigable waters, Arid lands.

States in arid regions are concerned over the federal reserved rights termed 'Indian Rights to Water', which include such concepts as navigation improvement and flood control plans. Recently a large number of lawsuits concerning water based on the Winters' Doctrine been filed in arid states. The protection of federal reserved water rights can be seen in such landmark cases as the U.S. vs. Rio Grande Dam and Irrigation Company (1899), Winters vs. U.S. (1908), Federal Power Commission vs. Oregon (1955), Arizona vs. California (1963), and U.S. vs. District Court for Eagle County (1971). The existing lawsuits on surface water sources such as the one now on appeal involving reserved federal rights on the Truckee River have promulgated two standards for deciding on the use of reserved waters. Those uses needed to fulfill the purposes contemplated when the reservation was created will be considered under one plan, while all possible uses, including those which appear in the future, without reference to the purposes for which the reservation was created, will form a second plan for reserved water use. The first plan allows a rapid quantification of the reserved water rights to identify and protect a certain amount of water from others. In the second case, the Indians' rights would remain uncertain, and the courts may be able to force the Indians to accept compensation for their claim if no water is available. (Geiger-FRC)
W82-04446

NEW FEDERAL WASTEWATER DISCHARGE STANDARDS IN GERMANY,
Ministry of the Interior, Berlin (Germany, F.R.).
H. Hornef, and S. Kanowski.
Effluent and Water Treatment Journal, Vol 21, No 11, p 510, 511, 513, 514, November, 1981. 2 Tab, 2 Ref.

Descriptors: *Wastewater disposal, *Regulations, Standards, *Federal jurisdiction, *Industrial wastes, Water quality, *Water pollution control, *West Germany.

The federal government in Germany has enacted two general laws which emphasize the principle of precaution and the need for those who do the polluting to pay for the cost of cleanup. The Wastewater Charges Act rules that a fee has to be paid for discharging wastewater into receiving waters. This charge may be reduced by 50% if the minimum quality requirements are met. The minimum requirements are compulsory everywhere in the Federal Republic of Germany and are independent of the state of the receiving waters. These requirements are generally emission standards in the form of concentrations and/or load of pollutants specific for products. In 1977 the federal government established 50 task forces to develop proposals for minimum requirements on an industry-by-industry basis. The most important pollutants/parameters for which minimum requirements are to be fixed are those for which a wastewater charge has to be paid, including settleable solids, chemical oxygen demand, cadmium, mercury, and toxicity for fish. In specific branches requirements will be set for biochemical oxygen demand, hydrocarbons, phenols, cyanide, heavy metals, halogenated hydrocarbons, sulfide, ammonia, fluoride, phosphorus, and total suspended solids. State authorities will set requirements for pH and temperature parameters. (Baker-FRC)
W82-04527

EXPERIENCES WITH EEC GUIDELINE 75/440 ON THE QUALITY OF SURFACE WATERS FOR DRINKING WATER PRODUCTION IN THE MEMBER STATES (ERFAHRUNGEN MIT DER EG RICHTLINIE 75/440 UBER DIE QUALITAT VON OBERFLACHENWASSER FUR DIE TRINKWASSERGEWINNUNG IN DEN MITGLIEDSTAATEN).
GWF-Wasser/Abwasser, Vol 122, No 12, p 555-560, 1981. 5 Fig. English Summary.

Descriptors: *Legal aspects, *Water quality standards, *European Economic Community, International law, Drinking water, Potable water, Surface water, Water quality, Lead.

The European Economic Community (EEC) Council of Ministers' guidelines on surface water quality for drinking water, published in 1975, is critically reviewed. This guideline had a dual goal of preventing water pollution and protecting public health. Some European water managers have expressed the opinion that this guideline offers more hindrance than help. Implementation in many countries has placed the burden of assuring acceptable source quality on the water supply enterprise and has failed sufficiently to emphasize pollution prevention. Some water obtainment treatment techniques widely used in Europe are not covered by the guideline. No encouragement is provided for improving water quality beyond minimum standards. Not all of the recommended methods and standards are adequately defined. Since this guideline is in the process of being adopted in legislation of the EEC member countries, it is advisable that these problems be resolved as soon as possible. (Carroll-FRC)
W82-04547

THE FINANCING OF PRIVATE SMALL SCALE HYDROELECTRIC PROJECTS.
Franklin Pierce Law Inst. Center, Concord, NH.
For primary bibliographic entry see Field 6B.
W82-04633

A MANUAL FOR DEVELOPMENT OF SMALL SCALE HYDROELECTRIC PROJECTS BY PUBLIC ENTITIES.
Energy Law Institute, Franklin Pierce Law Inst. Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/CE/04934-45, Price codes: A03 in paper copy, A01 in microfiche. DOE/CE/04934-45, March, 1981. 39 p, 1 Tab.

Descriptors: *Hydroelectric plants, *Legal aspects, *Economic aspects, *Local givernments, Financing, Permits, Licensing, Dams, Construction, Feasibility studies, Legislation.

This manual is designed to provide guidance to towns, cities, counties and other political subdivisions which are interested in undertaking or participating in small scale hydroelectric (SSH) development within or close to their territorial boundaries. A SSH project is of 25 to 30 MW or less and utilizes an existing dam or structure or utilizes the site characteristics of partially breached dams or structures. Since 1978 new federal legislation has removed some of the obstacles to SSH projects and has created substantial incentives for development. The hydroelectric development process can be braken down into the following sequential steps: reconnaissance study: feasibility study; permits, licensing, and exemptions study; engineering design; power purchase negotiations; construction; and operation. Every political subdivision must examine its charter or enabling legislation in order to determine whether it is authorized to proceeed with development of a SSH project. Assuming the requisite authorization exists, the political subdivision may choose to be the sole owner, developer and operator, in which case the financing and other arrangements are straight-forward. Assuming state or local law permits, the political subdivision may consider joint development with a private development firm, the local investor owned utility or another political subdivision. Disposition of a site owned by a political subdivision can take a variety of forms: outright sale at auction, sale of an option to purchase, a lease resulting from a bidding system, or a management and development contract resulting from a competitive proposal system. Since at least 80% of the annual cost of a hydroelectric project consists of interest payments and capital amortization expenses, it is important to select a financing strategy that minimizes the cost of financing the project. (Moore-SRC)
W82-04634

APPLICATION OF THE AREA OF REVIEW CONCEPT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. T. Thornhill, T. E. Short, and L. Silka.
Ground Water, Vol 20, No 1, p 32-38, 1982. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Injection wells, *Water quality control, *Mathematical studies, *Computer models, *Oil wells, *Hydrostatic pressure, Groundwater management, Water quality management, Model studies, Digital computers, Aquifers, Groundwater movement, Drinking water, Injection wells, Regulations.

Underground Injection Control regulations require that the issuers of permits determine, within an 'area of review', whether a proposed injection operation has a potential for contaminating underlying or overlying aquifers through faults, wells, or other conduits that permeate the injection zone. The 'area of review' is defined as that area the radius of which is the lateral distance from an injection well or injection well pattern in which the pressure change due to injection operations may cause the migration of the injection and/or formation fluid into an underground drinking water supply. It is thus the area around an injection well where, during injection, the hydrostatic head of the formation fluid in the injection zone is equal to or greater than the hydrostatic head of underground sources of drinking water. A Theirs equation may be used to determine the zone of endangering influence to define the area of review. The concept was applied to Texas oil fields in Anderson County, Andrews County and Refugio County, where active injection wells already existed and sufficient data was available to determine the area of review. The Warner analytical method for determining pressure buildup and a programmable desk calculator and digital computer were used in this exercise. In studying areas that have numerous injection wells discharging into the same zone, it was suggested that the effect of all the wells on the pressure buildup be considered. (Geiger-FRC)
W82-04674

RECENT DEVELOPMENTS IN COLORADO GROUNDWATER LAW,
Davis, Graham and Stubbs, Denver, CO.
F. Hannay.
Denver Law Journal, Vol 58, No 4, p 801-823, 1981. 194 Ref.

Descriptors: *Water law, *Wells, *Water rights, *Colorado, *Groundwater management, *State jurisdiction, *Appropriation, Legal aspects, Riparian

rights, Water use, Tributaries, Surface water, Water allocation, Resources development, Water management, Equitable apportionment, Permits.

The developments in Colorado water law with respect to both tributary and nontributary groundwater are reviewed. Tributary groundwater is defined as any surface and underground water of the state that would affect the rate of flow of the natural stream into which it flows over a period of forty years or less. A case in which the use of groundwater for two wells would have affected the rate and flow of the Cache La Poudre River helped establish the definition of tributary groundwater. If a well's operation would not affect the flow in a stream until one hundred years or more after the commencement of pumping, such a water supply would be defined as nontributary groundwater. In 1965, House Bill 1066 gave the state engineer the authority to control existing and new wells in Colorado. The 1969 Water Rights Determination and Administration Act served to implement and refine the doctrine of maximum water utilization while preserving vested rights. Recent court cases which sought to clarify the 1969 Act were unsuccessful at this task. The Colorado Supreme Court must still decide if nontributary groundwater can be appropriated, and, if so, how and by whom. (Geiger-FRC)
W82-04679

BUBB V. CHRISTENSEN: THE RIGHTS OF THE PRIVATE LANDOWNER YIELD TO THE RIGHTS OF THE WATER APPROPRIATOR UNDER THE COLORADO DOCTRINE,
E. A. Rada.
Denver Law Journal, Vol 58, No 4, p 825-836, 1981. 88 Ref.

Descriptors: *Water rights, *Colorado, *Appropriation, *State jurisdiction, *Land tenure, Water law, Riparian rights, Legal aspects, Water use, Water allocation, Water management, Land rights.

The Colorado Doctrine, which was developed to permit maximum utilization of water, implies that a water right may be acquired separate from the land. This negates the importance of trespass in the determination of a valid water right as seen in the case of Bubb vs. Christensen. The private landowner's right to be protected against trespass is subordinate if the trespasser can clearly demonstrate his intent to appropriate water on or adjacent to another's property. The landowner's recovery will be limited only to damages rather than to denial of the appropriator's right to use the diverted water. If it can be demonstrated that the appropriator did not put the water to good use and wrongfully took the owner's land, then the landowner may obtain relief in a court of general jurisdiction in an action for trespass. The court decision handed down in Bubb vs. Christensen suggests that a private landowner's property may be taken by one holding a conditional water right without first making compensation to the owner. (Geiger-FRC)
W82-04680

NOTE, WATER FOR OIL SHALE: FRAMEWORK FOR THE LEGAL ISSUES,
C. Robinson, and M. E. Walta.
Denver Law Journal, Vol 58, No 4, p 703-714, 1981. 95 Refs.

Descriptors: *Oil industry, *Legal aspects, *Water quality, Water supply, Shales, Energy, *Oil shale, Water pollution sources, Industrial water, Process water, *Colorado.

The proposed oil shale industry in Colorado will have a significant impact on the limited water resources of the state in two vital respects - depletion of water quantity and degradation of water quality. Oil shale companies will compete with agriculture, municipalities, other industries and recreation for the state's limited water supplies and will face environmental concern over water systems already polluted by existing users and by nature. General information of a technical nature is presented about oil shale geology and technology in order to form a framework for the legal issues related to water for oil shale development. The paper considers water availability, geology of oil shale formation, technologies for shale development, water requirements of the industry, and anticipated water quality impacts. This background will facilitate understanding of the legal problems inherent in the acquisition and use of Colorado water. A multitude of legal problems will surface as the oil shale industry continues to seek adequate and dependable water supplies. These problems will be further compounded by the labyrinth of federal regulations and by Colorado's specialized water law system. Ultimate resolution of these legal questions by the courts will significantly influence Colorado's role in helping the United States achieve energy independence. (Baker-FRC)
W82-04681

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION: STATE OF THE ART,
New Hampshire Water Supply and Pollution Control Commission, Concord.
S. W Leavenworth.
Journal of the New England Water Works Association, Vol 95, No 4, p 245-247, December, 1981.

Descriptors: *Reservoirs, *Water pollution prevention, Water supply development, Surface water, Water pollution sources, *Legal aspects, Public health, *Concord, *New Hampshire.

Problems encountered during efforts to secure a covering for a storage reservoir in the City of Concord, New Hampshire, are reviewed. In the summer of 1969 high levels of coliform bacteria were noted in water samples collected from the high service portion of the distribution system, while samples from other parts of the system were of a much better quality. The high service portion was served by a ground level uncovered storage reservoir with a capacity of about two million gallons. Application to install a cover was granted, but when funding finally became available, the priority of other projects was put above the reservoir cover and the project did not begin as planned. After a hearing before the Commission, the City was ordered to install a cover. The objections which the city had presented stemmed mainly from an epidemiologist's report that there had been no statistical evidence linking waterborne disease outbreaks to uncovered reservoirs. However, this approach to reasoning disregards the entire concept of prevention. There is also ample evidence that the various improvements in water treatment and in knowledge of water supply and distribution have reduced the incidence of waterborne disease outbreaks dramatically. Eventually in the City of Concord, the technical aspects took second place to the legal approach, as the order of the Commission was eventually appealed by the City to the State Supreme Court. In the final judgment, the Commission won, but more on legal grounds than on health and safety evidence. (Baker-FRC)
W82-04700

AUCTIONS AND ALTERNATIVE PROCEDURES FOR ALLOCATING POLLUTION RIGHTS,
Texas Univ. at Austin. Dept. of Economics.
R. M. Lyon.
Land Economics, Vol 58, No 1, p 16-32, February, 1982. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Water pollution control, *Legal aspects, *Water rights, Industrial wastes, *Regulations, Effluent charges, Effluent limitations.

This paper considers both potential strategic behavior of dischargers bidding for rights and price-taking behavior. Particular attention is given to examining the types of auction procedures that could be used to implement rights sales by the government, if the approach of government sales is adopted. A special type of auction, a type of roves mechanism, that discourages strategic bidding by dischargers is contrasted with auctions that use a single clearing price as a method for government sales. Regulatory procedures are considered, as they represent a standard against which programs involving transferable rights can be compared. Under the single-price auction rights would be sold to the highest bidders for a price that could represent either the lowest accepted bid or the highest rejected bid. A discriminating auction is designed specifically to eliminate dischargers' incentives for strategic bidding. Based on both theoretical and practical considerations, it is concluded that there is a fundamental trade-off between reducing the financial burden of rights purchases and eliminating the incentives for strategic behavior. Very few dischargers in either of the two case studies presented would have lowered expenses under government sales of rights rather than under uniform treatment regardless of whether sales are by a single-price or incentive-compatible auction. The simulations also suggest that there may be opportunities for strategic behavior under nonincentive-compatible procedures because of small numers of dischargers. The rights allocation approach of free distribution followed by exchange may present the most desirable package of features. (Baker-FRC)
W82-04746

6F. Nonstructural Alternatives

EXPERIMENTS IN IMPROVING RURAL WATER SUPPLIES,
Vermont Univ., Burlington. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 5F.
W82-04350

MASSACHUSETTS WATER SUPPLY PRIORITIES,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
For primary bibliographic entry see Field 6D.
W82-04698

FLOOD HAZARD IDENTIFICATION AND FLOOD PLAIN MANAGEMENT ON ALLUVIAL FANS,
Army Engineer Div. North Pacific, Portland, OR.
L. M. Hagura, and D. E. Wood.
Water Resources Bulletin, Vol 16, No 1, p 56-62, February, 1980. 8 Fig, 6 Ref.

Descriptors: *Flood control, *Alluvial fans, Alluvial plains, Sedimentary structures, Floods, United States, Land management, *Flood plains, Flood plain management, California.

This paper focuses on a special study procedure that the Federal Insurance Administration (FIA) has developed and is requiring its flood insurance study contractors to utilize for identifying alluvial fan (AF) zones. The need for an appropriate AF hazard identification procedure was dramatically emphasized by the passage of Tropical Storm Kathleen over the desert areas of Southern California in September of 1976. The pattern of flood damage was more typical of midwestern tornado damage, with certain localities extremely hard hit and other adjacent communities experiencing little or no structural damage. The basic cause of the substantial flood damage was a failure on the part of the local planning and building officials and developers to recognize the true degree of flood hazard that exists on alluvial fans. The procedure is understandably crude compared to other flood hazard identification techniques applied to more conventional flood problems. (Baker-FRC)
W82-04738

6G. Ecologic Impact Of Water Development

HYDROGEOLOGIC EVALUATION OF WETLAND BASINS FOR LAND USE PLANNING,
Lowell Univ., MA. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2A.
W82-04439

MODELING THE ENVIRONMENTAL EFFECTS OF A NAVIGATION CHANNEL IN A TIDAL BAY,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient, R. W. Hall, and C. J. Newell.
Water Resources Bulletin, Vol 16, No 5, p 881-886, October, 1980. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Navigation canals, *Environmental effects, *Model studies, Mathematical models, Salinity, Simulation, Channels, Tidal basins, Hydrologic models, *Tidal waters, Bays, Louisiana, Vermilion Bay, New Iberia.

This paper documents the use of a mathematical bay model to predict the environmental impacts of a proposed navigation channel from the Port of New Iberia, Louisiana, to the Gulf of Mexico through Vermilion Bay. Although these large bays cover an area of 293,895 acres, they are rather shallow, with depths averaging 5 to 7 feet. Models wer used to predict the changes in flow and salinity in the bay system under a variety of flow, wind, and channel conditions. The major assumptions in the model were that the bay is vertically well mixed, significant variations in depth from cell to cell do not occur at more than a few places in the bay, Atchafalaya inflows do not appreciably alter the tidal variation input to West Cote Blanche Bay, salinities are based on tidally averaged flows and do not represent actual peaks and lows within a tide cycle, and source salinities and source tides are assumed to correspond, although actual data were not simultaneously available for both. The model predicted that average salinity in the Vermilion Bay system would decrease with both high south winds and high fresh water inflows when compared to standard conditions. With a navigation channel incorporated in the model, average bay salinities were predicted to be lower for all three simulation cases. This project also pointed out the crucial role of complete input data in the effective appraisal of major projects such as the Vermilion Bay channel. Environmental impacts of major projects do not always follow the course of similar projects, as seen by the Vermilion Bay model results when compared to other channels constructed on the Gulf Coast. (Baker-FRC)
W82-04449

SIMULATED HYDROLOGIC EFFECTS OF POSSIBLE GROUND-WATER AND SURFACE-WATER MANAGEMENT ALTERNATIVES IN AND NEAR THE PLATTE RIVER, SOUTH-CENTRAL NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
A. W. Burns.
Geological Survey Open-File Report 81-1116, 1981. 41 p, 21 Fig, 5 Tab, 10 Ref, Append.

Descriptors: *Surface-groundwater relations, *Wildlife habitats, *Water management, Wetlands, Aquifers, Groundwater recharge, Streamflow, Irrigation, *Nebraska, *Platte River.

Digital computer models were developed and used to simulate the hydrologic effects of hypothetical water-management alternatives on the wetland habitat area near Grand Island, Nebr. Areally distributed recharge to and discharge from the aquifer system adjacent to the Platte River between Overton and Grand Island were computed for four hypothetical water-management alternatives. Using stream-aquifer response functions, the stream depletions resulting from the different alternatives ranged from 53,000 acre-feet per year for increased surface-water irrigation to 177,000 acre-feet per year for increased ground-water pumpage. Current conditions would result in stream depletions of 125,000 acre-feet per year. Using the relationship between discharge and river stage, frequency curves of the stage in the river near the wildlife habitat area were computed using a 50-year sequence of historical streamflow at Overton, minus the stream depletions resulting from various management practices. For the management alternatives previously discussed, differences in the stage-frequency curves were minimal. For comparative purposes, three additional water-management alternatives whose application would change the incoming streamflow at Overton were simulated. Although in these alternatives the amounts of water that were diverted or imported were similar to the amounts in the previous alternatives, their effects on the stage-frequency curves were much more dramatic. (USGS)
W82-04509

INERTIA AND RECOVERY: AN APPROACH TO STREAM CLASSIFICATION AND STRESS EVALUATION,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
J. R. Stauffer, Jr., and C. H. Hocutt.
Water Resources Bulletin, Vol 16, No 1, p 72-78, February, 1980. 2 Fig, 3 Tab, 36 Ref.

Descriptors: *Stream classification, *Stress, *Fish, Classification, Elastic properties, *Ecosystems, Biological communities, Water management, Streams, Inertia.

The feasibility of using a system based on inertia and elasticity was examined, and these concepts were applied to fish data collected by Hocutt and Stauffer on Conowingo Creek. For the purposes of the study, Conowingo Creek was divided into four sections based on stream order and gradient. The concept of inertia and elasticity was able to be used to formulate a stream classification system, which can predict the amount of stress a particular system can assimilate and the potential of a system to recover if and when the assimilative capacity is exceeded. In this example a stress at any of the upstream locations would probably affect downstream areas, and therefore both inertia and elasticity indices would be more realistic if calculated for separate tributaries of a major drainage basin. These types of analyses must be applied to various ecosystems using different phyletic groups before this system can be fully evaluated. In this study fish were used because they occupy the top of the food chain in most stream systems, and thus their presence implies the presence of many other phyletic groups. Fish also pass through most, if not all trophic levels above the primary producer stage as their development proceeds from larvae through adults. Inertia appeared to be a more useful concept than elasticity for predicting the effects of potential stress. The relationship between structural and functional redundancy and their influences on the inertia index are discussed. (Baker-FRC)
W82-04735

MAN-MADE STORAGE OF WATER RESOURCES-A LIABILITY TO THE OCEAN ENVIRONMENT. PART I,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
H. J. A. Neu.
Marine Pollution Bulletin, Vol 13, No 1, p 7-12, January, 1982. 11 Fig, 11 Ref.

Descriptors: *Ecological effects, *Water storage, *Runoff cycle, *Cycling nutrients, *Electric power production, Runoff, Seasonal variation, Estuaries, Salinity currents, Saline-freshwater interfaces, Tidal marshes, Continental shelf, Density currents.

The storage of spring and summer runoff to generate electric power may pose a serious threat to the freshwater supply required by estuaries, embayments, marshes, and continental shelves for the mixing and entrainment of nutrient-rich deep water into the surface layer. Along the northeastern United States and the eastern coast of Canada, the typical winter runoff of freshwater is small, but the spring and summer freshwater runoff into the estuaries is much larger. Reducing the flow of freshwater during spring and summer and increasing it during winter alters the seasonal composition of the water in the surface layer and the seasonal strength of the density current. Studies of salinity in the south side of Cabot Strait before regulation commenced, and in the 1970's after runoff regulation showed that drastic increases in salinity occurred after regulation and much of the cyclic variation in salinity had disappeared. If the trend continues, the cyclic variation will be reversed, summer and winter temperatures will probably increase and the strength of the density current may decline to the point of disappearance. Reductions in the transport of salt water will be accompanied by a decrease in the influx of nutrients during the active season of the year. (Geiger-FRC)
W82-04749

7. RESOURCES DATA

7A. Network Design

REQUIREMENTS FOR CONTINUOUS AUTOMATIC WATER QUALITY MONITORING IN THE THAMES ESTUARY,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 2L.
W82-04591

A DATA ACQUISITION SYSTEM FOR RECORDING AND PROCESSING RIVER QUALITY MONITORING DATA,
Severn Trent Water Authority, Coventry (England).
J. Cope.
Water Science and Technology, Vol 13, No 11/12, p 699-706, 1981. 13 Ref.

Descriptors: *Rivers, *Water quality, *Monitoring, Automation, Data acquisition, Water management, Equipment, Data processing, *Severn-Trent Water Authority, England.

In the Severn-Trent Water Authority a selection of commercial monitors is used together with specialist in-house developed monitors to help give a comprehensive water quality picture. Monitoring statins are expected to fulfill the two roles of sounding an alarm in the event of a polution problem and gathering historical quality data at that site. The procedure used to minimize false call-outs is briefly reviewed. The automatic data acquisition system is described, including data logger operations, and data recovery. Sensor technology has not as yet developed sufficiently to enable an automatic monitoring system to measure determinands which are most desirable, or if this is possible, costs are frequently prohibitive, particularly if a number of stations are required. At present, monitoring stations frequently measure determinands which may hint at undesirable contaminatino, but do not allow this to be quantified or identified unequivocally. Current sensors and sampling systems have a significant failure rate; consequently a limited proportion of erroneous results should be expected and dealt with accordingly. (Baker-FRC)
W82-04592

AUTOMATIC COLLECTION AND TRANSMISSION OF DATA FOR THE FEDERAL WATERWAY AUTHORITY.
Bundesanstalt fuer Gewasserkunde, Coblenz (Germany, F.R.).
F. Gunneberg.
Water Science and Technology, Vol 13, No 11/12, p 657-662, 1981. 1 Fig, 1 Tab.

Descriptors: *Automation, *Data transmission, *Data acquisition, Water quality data, On-site data collections, Hydrologic data, Flood data, Water level, Rivers, Germany, Remote control, Computers.

The West German Federal Waterway Authority is installing remote control equipment at its gauging and water quality monitoring stations in order to save labor costs and provide instantaneous access to water level data for flood prediction and pollution monitoring. Transmission is via the authority's own telephone lines. On-site storage of data for several days is provided in case of service interruption. Check channels are provided. Analog data from temperature, conductivity, acidity, and other sensors are transformed by an analog-digital converter, whereas water level data are obtained in digital form by coupling an optical encoder to the standard gauging facility. A quartz clock controlled microprocessor calls up gauging data every full minute, averages the data every 15 minutes, and stores the value in solid state memory. This procedure smooths the ripple caused by passing ships. Up to 22 sensors can be connected to one field station. The microprocessor is restarted every

day at midnight in order to protect against program execution breakdown due to power failures and the like. Maintenance personnel visiting the field station can plug in a liquid crystal display to read out the last values registered and the clock setting. Additional facilities are provided on regulated rivers. (Carroll-FRC)
W82-04596

DATA ACQUISITION FOR RIVER MANAGEMENT,
Thames Water Authority, Berkshire (England).
C. A. Hanson.
Water Science and Technology, Vol 13, No 11/12, p 687-692, 1981. 2 Ref.

Descriptors: *Water management, *Data acquisition, Computers, Monitoring, Automation, Rivers, *Thames River, River Lea, Catchment areas, *River systems, River management.

The requirements for data and information to manage and control a river system go beyond those for single process control. These requirements are discussed along with the philosophy of operation for the Thames Water data acquisition and control system for river management. This system has been operational since 1979. The system covers the catchments of the freshwater Thames above Teddington Lock and the River Lea, a major catchment which discharges directly to the tidal Thames and whose lower reaches pass through the outer conurbation of north east London. Both rivers have a navigational function. One of the additional requirements in river management beyond water supply and sewage treatment functions is for continuous time-series data as a prerequisite of system understanding before any meaningful control objectives can be established. Catchment data is also required to make projections for planning purposes. In river management data acquisition must be commenced in anticipation of problems to be met years ahead, and the quality of the data should assume decreasing margins of error and improving modelling techniques able to take advantage of the data quality. The first stage of the Thames Water data acquisition system consisted of a radio communications network, a computer control system and 67 field stations. Most of the difficulties encountered in commissioning the system revolved around the computer. At present attempts are underway to integrate the system of data from a precipitation radar station into the overall scheme. (Baker-FRC)
W82-04601

7B. Data Acquisition

A PRELIMINARY STUDY OF COMPARATIVE MEASUREMENTS OF RAINFALL RATE USING THE DIFFERENTIAL REFLECTIVITY RADAR TECHNIQUE AND A RAINGAGE NETWORK,
Ohio State Univ. Columbus. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 2B.
W82-04263

DIFFERENCES BETWEEN SOME RADAR RAINFALL ESTIMATION PROCEDURES IN A HIGH RAIN RATE GRADIENT STORM,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 2B.
W82-04265

ELECTROMAGNETIC MEASUREMENTS OF TIDAL TRANSPORTS IN ESTUARIES,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
E. M. Swenson.
Estuaries, Vol 4, No 3, p 161-166, 1981. 7 Fig, 17 Ref.

Descriptors: *Estuarine environment, *Tidal rivers, Electromagnetic waves, *Tidal range, *Measuring instruments, Monitoring, Flow, Flow measurement, Tidal flow.

An electromagnetic method for monitoring tidal flow, inexpensive and relatively maintenance free after deployment, is presented. This provides a possible alternative transport measurement system for understanding tidal transports. Comparison of the electric potential signal to transports determined from current meter records is used to calibrate the system. The method depends on the measurement of the electric potential produced across a tidal channel by tidal currents. The induced potential is proportional to the vector cross product of the magnetic field of the earth and the water velocity. A volume flow of 100 cubic meters per second will induce a potential near 1 mV. Examples are given of measurements taken at Great Bay, New Hampshire and Lake Pontchartrain, Louisiana. These examples illustrate the observation that the method is capable of yielding volume flow measurements with an uncertainty of about 15%. The method does have some limitations due to salinity and temperature changes, calibration drift, and lack of definition of the spatial characteristics of the flow. (Baker-FRC)
W82-04296

ICHTHYOPLANKTON SAMPLERS FOR SIMULTANEOUS REPLICATE SAMPLES AT SURFACE AND BOTTOM,
North Carolina State Univ. at Raleign. Dept. of Zoology.
R. G. Hodson, C. R. Bennett, and R. J. Monroe.
Estuaries, Vol 4, No 3, p 176-184, 1981. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Sampling, *Estuarine environment, *Plankton, Fish, Biomass, *Measuring instruments, Bottom sampling, Sampling devices.

The construction and use of some new and modified ichthyoplankton sampling devices are described. These devices can be operated from small, relatively fast boats in shallow estuarine waters using nets up to 1 meter in diameter. The gear uses one meter diameter nets on square and rectangular frames and provides simultaneous surface and bottom samples. The equipment provides quantitative and qualitative ichthyoplankton samples from shallow estuarine waters 1 to 12 meters deep. Filtration performance in relation to clogging of 505 micron mesh nets averaged 97% and 103% for the surface and bottom nets respectively. These high filtration rates were attributed to the design of the net frames, which apparently act as mouth reducing cones. Catch data for several species from the side-by-side and separated rigs were analyzed with a nested model of analysis of variance. No systematic error was noted to be inherent in the design of the two samplers, which precluded direct comparison of surface and bottom samples taken with them. (Baker-FRC)
W82-04297

MEASUREMENT OF AIR IN FLOWING WATER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
A. F. Babb, and H. C. Aus.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1615-1630, December, 1981. 16 Fig, 6 Ref.

Descriptors: *Bubbles, *Air entrainment, *Flow characteristics, Anemometers, Hydraulics, Water flow, Spillways, Flow velocity, Hot-film anemometer, Duration factor, Hydraulic engineering.

Air void fraction and bubble size were measured by the hot-film anemometer method, modified by a gamma-ray attenuation technique for calibrating the duration factor for the hot-film procedure. The duration factor, a function of velocity, varied from 1.5 msec for a velocity of 0.5 m per sec to 0.5 msec for 3.5 m per sec. Errors produced by computer identification of a nonexistent bubble and failure to detect the end of the bubbles were minimized by concurrent display of the anemometer signal and a computer signal indicating whether air or water was being detected. Minimum detectable bubble size was a function of the duration factor, and in turn, of velocity. Void ratio and bubble size were studied in a stable hydraulic jump maintained at a Froude number of 6. Larger bubbles, about 10 mm, were located near the upstream end of the jump. Larger bubbles were easily broken by turbulence, shear, and buoyancy. (Cassar-FRC)
W82-04322

A PROBE METHOD FOR SOIL WATER SAMPLING AND SUBSURFACE MEASUREMENTS,
Alaska Univ., Fairbanks. Geophysical Inst.
W. D. Harrison, and T. E. Osterkamp.
Water Resources Research, Vol 17, No 6, p 1731-1736, December, 1981. 5 Fig, 16 Ref.

Descriptors: *Soil water, *Sampling, *Sediment sampler, Interstitial water, Permafrost, Sea ice, *Beaufort Sea Shelf, Alaska, Hydraulic conductivity, Water pressure, Temperature, Measurements, Water sampling.

An apparatus for obtaining interstitial soil water samples was applied in a study of sediments under the sea ice of the Beaufort Sea Shelf, Alaska. The portable, inexpensive sampler consists of a probe, metal shield, porous metal filter, and a check valve connected to the surface by plastic tubing inside a drill rod. It is designed for use in the saturated zone and works best in coarse-grained sediments difficult to sample by other methods. The water sample is removed with a bailer inside the tubing. It is not necessary to remove the probe between samples at different depths in the same hole. The apparatus may also be used to measure hydraulic conductivity, temperature, and water pressure. Special problems encountered in working with the permafrost sediments were: the interstitial soil water was partly frozen and only the liquid phase was collected, freezing in the tubing occurred occasionally, and bailers and sometimes tubing had to be warmed electrically before using. (Cassar-FRC)
W82-04325

SEDIMENTATION RATES AND DEPOSITIONAL PROCESSES IN LAKE SUPERIOR FROM PB210 GEOCHRONOLOGY,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W82-04380

EVALUATION OF ELECTROMAGNETIC TERRAIN CONDUCTIVITY MEASUREMENTS FOR DETECTION AND MAPPING OF SALT-WATER INTERFACES IN COASTAL AQUIFERS,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5A.
W82-04412

A NEW METHOD FOR SAMPLING SNOW MELT AND RAINFALL IN FORESTS,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, and W. B. Fowler.
Water Resources Bulletin, Vol 16, No 5, p 938-940, October, 1980. 2 Fig, 7 Ref.

Descriptors: *Snowmelt, *Measuring instruments, Lysimeter, Rainfall, Precipitation, Snow, Forest soils, Forest watersheds, Remote sensing, *Automation.

A technique is described for automatically recording the rate of snow melt at remote sites. The method can also be used for estimating liquid precipitation at the soil surface. The advantages of the method include the fact that water input to the forest floor is sampled directly and corrections for interception are not required; that windeffects on moisture deposition are completely avoided; that the system operates unattended for long periods of time; that the system is versatile in that the number and size of catch pans can be changed according to expected point to point variability in melt rates, and the size of the buckets can be changed; and the system can be adapted to a telemetering system for data transfer. (Baker-FRC)
W82-04435

THE USE OF LANDSAT IMAGERY IN GROUND WATER EXPLORATION,
Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
K. E. Foster, R. A. Schowengerdt, and C. E. Glass.
Water Resources Bulleting, Vol 16, No 5, p 934-937, October, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Groundwater, *Remote sensing, *Landsat, Satellite technology, Water resources development, Water supply development, Water supply, *Arizona, Mapping, *Geohydrology.

A study was undertaken in 1978 to develop methods of exploring for water supplies based upon faulting detectable in satellite imagery. Northeastern Arizona was the site of the study. Control sites near Flagstaff and St. Johns were selected for more detailed investigation. The study was conducted in three phases. During Phase I lineaments ithin the entire study area were mapped using standard Landsat 1:250,000 scale, false color composites. Phase II, conducted simultaneously with Phase I, consisted of an inventory within the two study sites of well location, depth, land-surface altitude, yield, drawdown, specific capacity, and transmissivity. Four hydrologic parameters were chosen to correlate with lineament data: specific capacity, transmissivity, water temperature, and specific conductance. During Phase III a methodology was developed to correlate mapped lineaments with the hydrologic data. A well centered grid model was used in which the cumulative length of lineaments within a specified radial distance from each well was correlated with the four hydrologic parameters by use of linear regression. The correlations developed between lineament density and water data for the Flagstaff and Springerville well fields support the hypothesis that a relationship exists between regional geologic structure and well production. The study indicates that if there is a relationship between Landsat mapped lineaments and smaller fracturing in a given area, this two stage procedure can provide an efficient approach to groundwater exploration over large areas. (Baker-FRC)
W82-04436

SOIL CONSERVATION SERVICE RUNOFF CURVE NUMBER ESTIMATES FROM LANDSAT DATA,
Science and Education Administration, Athens, GA.
R. B. Slack, and R. Welch.
Water Resources Bulletin, Vol 16, No 5, p 887-893, October, 1980. 7 Fig, 5 Tab, 12 Ref.

Descriptors: *Remote sensing, *Runoff forecasting, Hydrology, *Watersheds, *Mapping, Topographic mapping, *Landsat, Computers, Erosion, Soil conservation.

The possibility of deriving Soil Conservation Service (SCS) curve numbers for large watersheds from Landsat digital data is discussed. A curve number is a quantitative descriptor of the land cover/soil complex and is commonly assigned based on information gained from field surveys and interpretations of aerial photographs. The current study took place over the Little River watershed near Tifton, Georgia, an area of about 125 square miles. Landsat data was used to generate a classification map of this area with four hydrologically important classes: agricultural vegetation, forest, wetland, and bare ground. Missing soil data was interpolated from the vegetation patterns of the classification map. About half of the needed data was available from the Landsat experiment. A modification of the SCS curve table number was developed and used to assign each pixel to a category. The average curve number for each of six subwatersheds and for the entire watershed was then computed and compared with SCS values for the same areas. Agreement was to within two curve number units. The multitemporal aspect of Landsat permits the selection of image data at periods of the year when land cover and runoff considerations are critical to hydrologic studies. The digital format of Landsat data is compatible with the input requirements of hydrologic models. It appears feasible to combine in a data base the CN's for pixel or grid cell sized units with information on soils, precipitation, slope, aspect, vegetation, and land use. Such an approach would permit refinement of hydrologic models. (Baker-FRC)
W82-04438

RIDGE REGRESSION TECHNIQUES APPLIED TO LANDSAT INVESTIGATION OF WATER QUALITY IN LAKE OKEECHOBEE,
Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2H.
W82-04440

TESTS OF FRAZIL COLLECTOR LINES TO ASSIST ICE COVER FORMATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W82-04460

ANALYSIS AND PREDICTION OF WATER MOVEMENTS AND WATER QUALITY IN A SHALLOW RIVER IMPOUNDMENT. APPLICATION TO MISSISSIPPI RIVER POOL NO 2,
A. C. Demetracopoulos.
PhD Thesis, June, 1981. 280 p, 70 Fig, 7 Tab, 190 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25950.

Descriptors: *Water quality, *Flow system, *Hydrologic aspects, *Model studies, Dissolved oxygen, Water circulation, Ponds, Mass transfer, *Impoundments, River systems, *Mississippi River, Water movement, Temporal variation, Spatial variation, Flow analysis.

The physical processes governing water circulation and hydrologic mass transport, as well as some of the biochemical processes determining the oxygen characteristics of shallow river impoundments are studied. Flow analysis is performed for an interconnected system of channels and for quasi-steady state conditions. The bulk flow is examined and interest is focused on the dynamic behavior of the flow. The response time of the aquatic system to changing wind conditions is examined in a simplified unsteady flow analysis. The study is extended to the water quality of shallow run-of-the-river impoundments. The main quality parameters are dissolved oxygen and algal biomass, The formulation and incorporation of the source and sink terms are addressed in the study. The validity of the combined hydrodynamic/transport/water quality model is checked against field measurements obtained in Pool 2 of the Mississippi River. The results are reasonable and show the significance of several interacting processes on dissolved materials and in particular dissolved oxygen very clearly. The model predicts concentrations of a dissolved conservative tracer or material, of dissolved oxygen, chlorophyll-a and water temperature. It is particularly suitable for low flow summer conditions when wind effects become significant or dominant and water quality exhibits strong temporal and spatial variations. (Sinha-OEIS)
W82-04482

WATER QUALITY MONITORING SYSTEM IN NIEDERSACHSEN - APPLICATION OF AUTOMATIC STATIONS FOR CONTROL AND MONITORING OF WATER QUALITY,
Niedersachsisches Wasseruntersuchungsamt, Hildesheim (Germany, F.R.).
V. Plate.
Water Science and Technology, Vol 13, No 11/12, p 671-676, 1981. 1 Fig, 1 Ref.

Descriptors: *Water quality, *Monitoring, Flood protection, *Automation, *Data transmission, Data acquisition, *Germany, Lower Saxony, Networks, Costs, Water level, Water resources management.

A network of 36 automatic monitoring stations is being developed in Lower Saxony in accordance with the reorganization of the water quality surveillance system now being undertaken. This network will be connected with a surveillance center in Hildesheim. The monitoring system will offer continuous observation of the water quality, allow for early recognition and announcement of deterioration or dangerous situations, and provide basic documentation for the purposes of studying water resources policies and management. The system will be completed by 1985. Principles, tasks and aims of the surveillance system as well as technical equipment of the monitoring stations, methods of data acquisition and transmission and the organization of the surveillance center in Hildesheim are described. Some timing and cost information is presented. About 30 of the most important water level gauge stations will be equipped with instrumentation appropriate for digital acquisition of water level measurement values and remote data transmission, especially for the purpose of flood protection. (Baker-FRC)
W82-04575

MANUAL GROUNDWATER SAMPLING DEVICE (VORRICHTUNG ZUR MANUELLEN WASSERPROBENENTNAHME AUS GRUNDWASSERMESSSTELLEN),
Forschungszentrum Wassertechnik (German,D.R.).
V. Peukert.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 336, 1981, 1 Fig. (No English summary).

Descriptors: *Groundwater, *Sampling, *Equipment, Automation, *Water quality, Water sampling, Dissolved oxygen, Germany.

The standard technique for groundwater quality analysis in the German Decocratic Republic requires that the collecting tube be flushed before the sample is collected, a procedure which was difficult to accomplish with existing sampling devices. A new device was developed which permits a representative groundwater sample to be collected, based on a vacuum principle. This principle requires a difference of less than 9 m in height between the groundwater level and the sampler. A converted automatic air pump creates a vacuum, maintained by means of a check valve, in the sampling line. Water is drawn up through the collecting tube. Once the collection vessel is filled, ambient pressure is restored by opening a three-way stopcock, and the water collected is either placed in the sampling bottle or discarded. A water volume at least equal to the volume of tubing between the water level and the filter area is pumped out and discarded. Then the sample is drawn off from just above the filter. Introduction of oxygen to the sample is prevented by keeping the system closed and filling the reservoir completely during sampling. The desired sample water volume is carefully pipetted from the reservoir into a sample bottle. (Carroll-FRC)
W82-04582

UTILIZATION OF DATA FROM AUTOMATIC WATER QUALITY MONITORING STATIONS IN FINLAND,
National Board of Waters, Helsinki (Finland). Water Research Inst.
T. Kohonen.
Water Science and Technology, Vol 13, No 11/12, p 631-637, 1981. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Water quality, *Monitoring, *Automation, Computers, Data acquisition, Water management, *Finland, Networks, Turbidity, Dissolved oxygen, Rivers, Hydrogen ion concentration, Chloride, Kymyoki River, Kokemaenjokia, *Data transmission.

The Kymijoki River and Kokemaenjoki River monitoring network comprises five land-based river stations and a central computing unit consisting of a PDP 11/35 computer located at the Helsinki office of the National Board of Waters. The system began service in September of 1977. Data transfer from the station occurs twice daily via leased public telephone lines and is initiated by the computer. Data can also be requested manually from a control terminal if the need arises. Every monitoring station measures temperature, pH, conductivity, dissolved oxygen, turbidity, and chloride level at five stations and redox potential at two of the stations. In seven sstations the measuring cham-

ber also houses the built-in ultrasonic transducers for cleaning the sensors hourly, together with the drive motors needed for daily calibration and cleaning cycles. The quantity of the data gathered allows the use of statistical procedures for estimating the optimal sampling frequencies. (Baker-FRC)
W82-04585

RECENT DEVELOPMENTS IN AND APPLICATION OF AUTOMATION AND MONITORING IN WATER MANGEMENT,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden-, und Lufthygiene.
R. Leschber.
Water Science and Technology, Vol 13, No 11/12, p 715-719, 1981.

Descriptors: *Water management, *Reviews, *Monitoring, Automation, Water supply, *Water quality, Water quality control.

This communication briefly reviews the main subjects presented at the Congress and Exhibition 'Wasser Berlin '81' and the essential new ideas and results of research. The range of subjects covered at the conference included general reports on the present and future role of automation and related fields in water management as well as papers which dealt with telemetry and micro-processors. Monitoring of surface waters and other drinking water sources made up another group of subjects. The bulk of papers pertained to the subjects of water treatment and supply. The two most advanced systems operating in Switzerland were described, one of which operates without any technical staff and the other where staff can rely on the most conemporary aids of data processing. Data flow, data storage, and data retrieval in the form of periodic reports were described. In the fields of water treatment the major subjects were dosage of chemicals and monitoring of the success of the individual stages of treatment. Automation of sequences of procedures or complex methods of treatment was considered. The great advantage of using a computer with reserve capacity for specific raw water treatment was considered. Water supply was covered in papers dealing with general problems of the operation of municipal networks and a number of specific subjects. The various applications of servosystems for the operation of pumps and valves were described. (Baker-FRC)
W82-04593

STORM SEWER FLOW COMPUTATIONS,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
K. Sivaloganathan.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 513-522, June, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Sewer systems, Lateral sewers, *Pipe flow, *Storm sewers, Hydraulics, *Flow characteristics, Hydrographs.

A new technique for dealing with storm sewer flows involving concentrated lateral inflows at junctions is described. Using St. Venant equations, each concentrated lateral inflow is replaced by a triangularly distributed lateral inflow over the adjoining few distance steps. The diffusing and the Lax- Wendroff methods were most suitable for solving the St. Venant equations with this technique. The implicit method of Strelkoff may be used if the equivalent triangular distribution of each concentrated lateral inflow is not done over too small a distance. Methods unsuitable for this technique were the rectangular grid broken characteristic scheme and the leap frog method. Depth hydrographs prepared from experimental and computed data were in good agreement. (Cassar-FRC)
W82-04640

THE DEVELOPMENT OF A VIABLE METHOD OF STREAM FLOW MEASUREMENT USING THE INTEGRATING FLOAT TECHNIQUE,
Lancaster Univ., Bailrigg (England).
D. M. Sargent.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 1-15, March, 1981. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Flow measurement, *Streamflow, *Bubbles, Integrating float method, Photography.

The integrating float method for measuring streamflow was modified by using air bubbles as rising floats. This method, first suggested a century ago, has never been practical because the buoyant floats in the stream were difficult to locate. A length of pipe was installed in a straight line across the river bottom. Air was forced through nozzles placed at intervals along the pipe to produce a line of rising air bubbles. Photographic equipment was set up on the bank to record the position of the air bubble line. Streamflow values obtained using the integrating float method in a medium-sized river were within -6 to +10% (average 1.3%) of streamflows measured by a weir. Errors were greatest at low and high flow. (Cassar-FRC)
W82-04643

REMOTE SENSING OF ATMOSPHERIC WATER CONTENT FROM SATELLITE MICROWAVE RADIOMETER (SAMIR) ON BHASKARA,
Indian Space Research Organization, Ahmedabad. Space Applications Centre.
P. C. Pandley, B. S. Gohil, and A. K. Sharma.
Mausam, Vol 32, No 1, p 17-22, January, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Meteorological data collection, Water vapor, Microwaves, Radiosondes, *India, Bay of Bengal, Arabian Sea, Satellite technology, Radiometry, *Bhaskara satellite.

Integrated abundances of water vapor and liquid water over oceans were determined from data obtained from the Indian satellite Bhaskara during its June 27, 28, and 29, 1979, orbits. Aboard the satellite is a microwave radiometer (SAMIR) with 19.35 GHz and 22.235 GHz channels. Values of water vapor and liquid water content, respectively, were: June 27 over the Arabian Sea, 4.0 g per sq cm and 0.5-0.7 kg per sq m; June 28 over the Bay of Bengal, 4.4-6.0 g per sq cm and 0.8-2.1 kg per sq m; and June 29, a tropical depression over the Bay of Bengal, 3.6-4.7 g per sq cm and 1.7-1.9 kg per sq m. Although no accurate data were available for comparison, the findings were in general agreement with mean monthly precipitable water radiosonde data from coastal stations and from APT pictures. (Cassar-FRC)
W82-04647

COLLAPSIBLE-BAG SUSPENDED-SEDIMENT SAMPLER,
Geological Survey, Lakewood, CO.
H. H. Stevens, Jr., G. A. Lutz, and D. W. Hubbell.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY4, p 608-611, April, 1980. 2 Fig, 5 Ref.

Descriptors: Water sampling, *Suspended sediments, Rivers, Estuaries, Measuring instruments, *Sediment sampler.

The U. S. Federal Interagency Sedimentation Committee has developed special sampling techniques and equipment to help ensure the collection of meaningful samples of the suspended-sediment load in rivers and estuaries. This paper describes a collapsible-bag sampler that is based on somewhat different operating principles than conventional U.S.-series samplers, but which has similar sampling characteristics and is used in the same manner as those samplers. This collapsible bag sampler facilitates the collection of samples from large rivers and estuaries because it permits the continuous collection of representative depth-integrated samples of water-sediment mixture in all water depths and velocity distributions and the convenient and quick collection of large volume samples. In addition, the maximum depth capacity of the sampler can be readily changed by altering the internal diameter of the nozzle or the volume of the sample bag. The nozzle of the container can easily be fitted with an off-on valve to permit the sampler to be used as a point-integrating sampler. The sampler is easy to use and to maintain, even in salt water. Various potential improvements in the sampler are also identified. (Carroll-FRC)
W82-04745

7C. Evaluation, Processing and Publication

WATERSHEDS AS THE BASIC ECOSYSTEMS: THIS CONCEPTUAL FRAMEWORK PROVIDES A BASIS FOR A NATURAL CLASSIFICATION SYSTEM,
Corvallis Environmental Research Lab., OR.
F. B. Lotspeich.
Water Resources Bulletin, Vol 16, No 4, p 581-586, August, 1980. 1 Fig, 27 Ref.

Descriptors: *Watersheds, *Ecosystems, *Stream classification, Classification, Climate, Geology, Soil, Vegetation.

A classification scheme for watersheds, based on the ecosystem concept, is outlined. Climate and geology are selected as the state factors. These two factors interact to produce a land form and in turn an ecosystem. Climate is considered the master factor, having overwhelming influence on all ecosystem features. Possible classes of climate can be based on size, the concept of equivalent latitude, or the isophane concept (lines of equal biological activity as a function of temperature, which is in turn a function of latitude and elevation). Geology classifications may consider bedrock. Transactional factors are soil and vegetation, which interact with climatic and geologic factors to form a variety of tesseras. The stream, at the bottom of the scale, is passive and does not interact with the higher factors in the ecosystem. The stream is a result of interactions of all the forces on the two higher levels. (Cassar-FRC)
W82-04253

DECISIONS UNDER VIOLATION OF REGRESSION NORMALITY,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
E. Castano, L. Duckstein, and J. Weber.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 549-561, October, 1981. 1 Tab, 5 Fig, 35 Ref.

Descriptors: *Mathematical models, *Statistical analysis, *Management planning, Decision making, *Regression analysis, *Hydrology, Prediction, Engineering, Monte Carlo methods, Simulation, Distribution.

The accuracy of hydrologic predictions based on regression analysis under the incorrect assumption of normality is investigated. Monte carlo simulation is used to investigate the small sample behavior of the estimated regression coefficients, estimated variances, and predicted values of the dependent variable when the errors are not normally distributed. The distributions simulated are lognormal, Pearson, and LogPearson with varying degrees of skew. The estimated values of the regression coefficients are not appreciably affected by skew of the error distribution. Decisions based on both the mean and variance are less robust to nonnormality than decisions based only on the mean. For example, whenever hydrologic decisions are based on a percentile, as in T-year floods, or on a confidence interval statement in regression analysis, as in flood plain zoning, standard deviations are involved, so that results may be sensitive to violation of the normality assumption. (Titus-FRC)
W82-04264

VERTICAL ROUND BUOYANT JET IN SHALLOW WATER,
Delaware Univ., Newark. Dept. of Civil Engineering.
J. H. W. Lee, and G. H. Jirka.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107,

No HY12, p 1651-1675, December, 1981. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Cooling water, *Mixing, *Thermal pollution, Dilution, Powerplants, Tracers, Dyes, Shallow water, Jets, Water pollution control, Buoyancy, Fate of pollutants, Hydraulics, Flow characteristics, Turbulent flow.

The stability and mixing characteristics of a round turbulent buoyant jet discharging vertically into a stagnant water body of large horizontal extent were investigated analytically and experimentally to determine the aquatic impact of thermal effluents. In the case of a stable discharge configuration, four flow regimes can be distinguishd: (1) initial buoyant jet region, where the discharge mixes with the ambient fluid by turbulent entrainment, (2) surface impingement region, where the buoyant mixed flow is turned into a radially outward moving supercritical flow, (3) radial internal hydraulic jump region, transferring the flow into a subcritical region downstream with loss of energy, and (4) stratified counterflow region, with negligible entrainment across the surface. These 4 regions are analyzed separately and the solutions combined to predict the stability criteria. A laboratory half jet and dye were used to observe flows under different conditions. Jet diameters varied from 1.0 to 0.25 inches; discharge velocities, 0.82 to 30.0 ft per sec; discharge excess temperatures, 21.4 to 34.8 F; initial ambient temperatures, 70.2 to 79.1 F; discharge flows, 0.31 to 3.20 gal per min; Froude numbers, 8.0 to 583.4; and Reynolds numbers, 6800 to 62,500. Stability or nonstability and near field dilution were noted. This study indicates that shallow site conditions limit the dilution possible with single port discharges. Alternative designs include moving the outfall to greater depths or using a multiport diffuser. (Cassar-FRC)
W82-04365

MAPS SHOWING GROUND-WATER CONDITIONS IN THE BILL WILLIAMS AREA, MOHAVE, YAVAPAI, AND YUMA COUNTIES, ARIZONA--1980,
Geological Survey, Tucson, AZ. Water Resources Div.
H. W. Sanger, and G. R. Littin.
Geological Survey Open-File Report 82-87 (WRI), November, 1981. 2 Sheets, 16 Ref.

Descriptors: *Maps, *Groundwater, *Aquifer characteristics, *Water quality, Water level, Wells, Springs, Specific conductivity, Fluoride, *Arizona, Mohave County, Yavapai County, Yuma County, Bill Williams River.

The Bill Williams area includes about 3,200 square miles in west-central Arizona. Most water used is from ground water, although a small amount of surface water also may be diverted. About 18,000 acre-feet of ground water was withdrawn in 1979. The main water-bearing unit is the basin-fill deposits, which consist of boulder to pebble conglomerate and interbedded coarse- to fine-grained sandstone, siltstone, mudstone, and in places rhyolitic and basaltic tuff. Depth to water, altitude of the water level, well depth, and specific conductance and fluoride concentration are shown on the 1:125,000-scale map of the area. (USGS)
W82-04488

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1981,
Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds.
Geological Survey Open-File Report 81-1114, September, 1981. 52 p, 5 Fig, 16 Tab, 18 Ref.

Descriptors: *Groundwater, *Groundwater level, *Hydrologic data, *Aquifers, Potentiometric level, Observation wells, Well hydrographs, Water measurement, Groundwater availability, *Arkansas, Sparta Sand.

This report contains about 600 ground-water level measurements made in observation wells in Arkansas in the spring of 1981. In addition, the report contains potentiometric surface maps and well hydrographs relating to the alluvial aquifer and the Sparta Sand, the most important aquifers with respect to groundwater availability and use in Arkansas. (USGS)
W82-04489

FLOOD AND RELATED DEBRIS FLOW HAZARDS MAP, LAS VEGAS SE QUADRANGLE,
Geological Survey, Carson City, NV. Water Resources Div.
T. Katzer.
Available from Nevada Bureau of Mines and Geology, Univ. of Nevada, Reno, Nevada 89557, Price: $2.50. Nevada Bureau of Mines and Geology Map 3A1, 1981. 1 Sheet.

Descriptors: *Maps, *Floods, *Detritus, *Hazards, Flood peak, Flood plains, Flood flow, Erosion, Deposition, *Nevada, *Las Vegas SE quadrangle.

This map shows flood and debris hazards on the Las Vegas SE quadrangle, Nevada. Estimates of the 100-year flood peak were made and the corresponding flood plains were outlined on the map for the principal drainages in the area. Degrees of hazard were assigned to the entire quadrangle on the basis of floodflows and potential debris movement. (USGS)
W82-04490

THICKNESS, PERCENT SAND, AND CONFIGURATION OF SHALLOW HYDROGEOLOGIC UNITS IN THE POWDER RIVER BASIN, MONTANA AND WYOMING,
Geological Survey, Billings, MT. Water Resources Div.
B. D. Lewis, and W. R. Hotchkiss.
Available from Western Distr. Branch USGS, Box 25286 Denver, CO 80225, Price: $12.50. Geological Survey Miscellaneous Investigations Map I-1317, 1981. 6 Sheets, 23 Ref.

Descriptors: *Maps, *Geohydrology, *Geohydrologic units, *Aquifer characteristics, Hydrologic data, Geology, Geological surveys, *Montana, *Wyoming, Powder River basin.

The shallow hydrogeologic system is composed of five distinct units, bounded at its base by the regionally widespread and relatively impermeable Bearpaw Shale. The units, which were in age from Late Cretaceous to Holocene, are in ascending order the Fox Hills-lower Hell Creek aquifer, upper Hell Creek confining layer, Tullock aquifer, Lebo confining layer, and Tongue River-Wasatch aquifer. Shallow hydrogeologic units mapped in the Powder River basin of Montana and Wyoming are of marine and continental origin. The Fox Hills Sandstone is a marine deposit with all overlying units representing continental conditions. Thick and extensive coal deposits are present in the Tongue River Member of the Fort Union Formation and the Wasatch Formation. Geologic and hydrogeologic data were used to separate the various units into a system of alternating aquifers anf confining layers. Physical characteristics used to describe the units were thickness, percent sand, and configuration of the base of each hydrogeologic unit. (USGS)
W82-04501

DISSOLVED-SOLIDS CONCENTRATIONS OF GROUND WATER IN THE SACRAMENTO VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman.
Available from Western Distr. Branch USGS, Box 25286 Denver, CO 80225, Price: $3.00. Geological Survey Hydrologic Investigations Atlas HA-645, 1982. 1 Sheet, 1 Tab, 14 Ref.

Descriptors: *Maps, *Dissolved solids, *Groundwater, *Water quality, Wells, Irrigation, Domestic water, Water analysis, Chemical analysis, Geohydrology, *California, *Sacramento Valley.

The general quality of the ground water in the Sacramento Valley, Calif., in terms of dissolved-solids concentration is considered good for irrigation, domestic, and most other uses. This map shows the distribution of dissolved-solids concentrations and is based on about 1,330 chemical analyses collected from about 900 wells between 1974 and 1978. On the west side of the valley some of the smaller streams contribute water of higher dissolved-solids concentrations to the ground water. The sources of these waters are thought to be the upper Cretaceous Chico Formation or marine deposits of Early Cretaceous age that are exposed in the Coast Ranges. (USGS)
W82-04502

WATER RESOURCES DATA FOR ARKANSAS, WATER YEAR 1980.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190380, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report AR-80-1, 1981. 585 p, 5 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Arkansas.

Water resources data for the 1980 water year for Arkansas consist of records of stage, discharge, and water quality of streams; and stage, contents, and water quality of lakes and reservoirs. This report contains discharge records for 60 gaging stations; stage and contents for four lakes and reservoirs; water quality for 152 stations, 69 partial-record flow stations, and eight lakes; and water levels for 79 observation wells. Also included are 116 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Arkansas. (USGS)
W82-04503

HYDROLOGIC RECONNAISSANCE OF THE BELUGA, PETERS CREEK, AND HEALY COAL AREAS, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
D. R. Scully, A. P. Krumhardt, and D. R. Kernodle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168402, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-56, 1981. 71 p, 37 Fig, 17 Tab, 31 Ref.

Descriptors: *Surface water, *Water quality, *Hydrologic data, *Coal mines, Streams, Flow characteristics, *Alaska, Beluga coal area, Peters Creek coal area, Healy coal area.

The Beluga, Peters Creek, and Healy coal areas in Alaska were studied during 1975-1978, with major emphasis on surface-water hydrology and water quality. In the Beluga coal area, mean annual discharge is estimated to range from 2.2 to 3.4 cubic feet per second per square mile of drainage area. The 7-day low flow with a 10-year recurrence interval is estimated to be 0.3 to 0.6 cubic feet per second per square mile. The surface waters are calcium bicarbonate type; have low concentrations of nutrients; and, at times, may contain dissolved iron and manganese in concentrations in excess of U.S. Environmental Protection Agency recommended limits. The pooled diversity index of the benthic invertebrate community ranges from 2.93 to 4.06. No ground-water wells have been drilled in the potential mining areas. Water quality of streams in the Peters Creek coal area is similar to that of the streams in the Beluga coal area. No attempt is made to define streamflow characteristics in the Peters Creek coal area due to poor correlations with nearby gaging stations. In the Healy coal area, streamflow characteristics are dissimilar between the two major basins studied. Lig-

nite Creek is estimated to have less yield than Healy Creek. Studied tributaries of Healy and Lignite Creeks contain waters with a dissolved solids range of 111 to 636 milligrams per liter and have calcium and bicarbonate or magnesium and bicarbonate as principal ions. Iron and manganese concentrations are high at some times of the year. The concentrations of sodium and chloride increases significantly in the lower reaches of Lignite Creek. (USGS)
W82-04504

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1981,
Geological Survey, Orlando, FL. Water Resources Div.
A. S. Navoy.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $2.50, Microfiche $0.50. Geological Survey Open-File Report 81-1198, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Pumping, Geohydrology, *Florida, Sumter County.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Fla., for May 1981. The Floridan aquifer is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the low water-level period. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 90 feet in the southeast part of the county to less than 35 feet northwest of Lake Panasoffkee in the west central area. (USGS)
W82-04507

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEAR 1979 AND 1980,
Geological Survey, Lawrence, KS. Water Resources Div.
H. E. McGovern, and L. J. Combs.
Geological Survey Open-File Report 81-348 (WRI), March, 1981. 107 p, 9 Fig, 5 Tab.

Descriptors: *Available water, *Water quality, *Groundwater, *Surface water, Water resources development, Water management, Aquifers, Selective withdrawal, Irrigation, Water use, Water supply, Streamflow, Runoff, Sediment transport, Flood frequency, Urbanization, Data collections, Publications, *Kansas, *Projects.

Activities of the U.S. Geological Survey in Kansas include the systematic collection and analysis of data to describe the framework of hydrologic systems, assess the water resources, define existing or potential problems in the quantity or quality of water, and provide information for optimum development and management of resources. Streamflow studies are made to determine availability of supplies and relations to rainfall runoff, urbanization, flood frequencies, and sediment-transport. Groundwater studies are made to determine the quantity of supplies available in aquifer systems, the effects of natural or artificial contamination, and the effects of withdrawals by irrigation, industrial, and municipal supplies. Water-quality studies are made to define physical, chemical, and biological characteristics in streams and principal aquifers, and to evaluate the chemical changes due to urbanization and surface mining. (USGS)
W82-04510

PROBABLE HIGH GROUND-WATER LEVELS ON CAPE COD, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
M. H. Frimpter.
Geological Survey Open-File Report 80-1008 (WRI), 1980. 20 p, 5 Fig, 4 Plates, 10 Tab, 7 Ref.

Descriptors: *Groundwater, *Water table, *Observation wells, *Water level fluctuations, Sites, Maps, Estimating, Massachusetts, *Cape Cod.

Water-level records from 146 short-term (1 year) observation wells and 13 long-term (16-28 years) observation wells were used to estimate the probable high ground-water level that could occur at any site on Cape Cod. The estimation was based on correlation of a single water-level measurement from a test site with water-level records of the nine index wells. Maps showing areas of Cape Cod represented by the nine index wells and showing five ranges of water-level fluctuation are used in conjunction with tables of water-level adjustments to make the estimates. (USGS)
W82-04511

PRELIMINARY DATA FROM ARBUCKLE TEST WELLS, MIAMI, DOUGLAS, SALINE, AND LABETTE COUNTIES, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
T. Gogel.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $20.00, Microfiche $3.50. Geological Survey Open-File Report 81-1112, 1981. 155 p, 54 Fig, 16 Tab, 3 Ref, 2 Append.

Descriptors: *Hydrologic data, *Aquifer characteristics, *Structural geology, *Cores, Test wells, Hydraulics, Water quality, Water analysis, Hydraulic conductivity, Logging(Recording), Geochemistry, *Kansas, Arbuckle Group, Miami County, Douglas County, Saline County, Labette County.

Preliminary data are presented for test wells in Kansas that were completed in Cambrian and Ordovician rocks of the Arbuckle Group in late 1979 and early 1980. Included in the report are hole history, electrical logs, geology (sample descriptions and cores), hydrologic testing, and geochemistry. These wells were drilled to determine the regional hydrology of the Arbuckle Group and to investigate the hydraulic characteristics of the formation at site-specific areas. The test wells were drilled in Miami, Douglas, Saline, and Labette Counties, Kansas. Depths of the wells ranged from 1,816 feet in Labette County to 3,665 feet in Saline County. Results of core analyses from rocks in the Arbuckle Group are presented for vertical and horizontal permeability to air, porosity, fluid saturation, acoustic velocity, resistivity indices, and formation factor. Formation data from drill-stem tests are presented for use in calculating transmissivity, hydraulic conductivity, and hydraulic head. Analyses of water samples from the test wells are presented to indicate water quality in the aquifers. (USGS)
W82-04512

WATER-QUALITY DATA FOR SELECTED STATIONS IN THE EAST EVERGLADES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $10.75, Microfiche $3.50. Geological Survey Open-File Report 81-821, 1981. 77 p, 6 Fig, 37 Tab, 1 Ref.

Descriptors: *Water quality, *Data collections, *Surface water, *Groundwater, Canals, Marshes, Bottom sampling, Water analysis, Nutrients, Trace elements, Algae, *Florida, Dade County, *Everglades.

The results of water-quality samples collected from April 1978 through April 1980 from three canal stations, four marsh stations, and two ground-water stations within the East Everglades, Dade County, Florida, are tabulated in 37 tables. The major categories of parameters analyzed are field measurements, physical characteristics, macronutrients (carbon, nitrogen, and phosphorus), major ions, trace elements, and algae. Chemical data for bulk-precipitation stations within and adjacent to the East Everglades are also given. The parameters analyzed include macronutrients, major ions, and trace elements. The period of record for these stations is October 1977 through April 1980. Bottom material at the canal and marsh stations was collected twice during the investigation. These data include analyses for macronutrients, trace elements, and chlorinated-hydrocarbon insecticides. (USGS)
W82-04513

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, TRENTON TO PENNSVILLE, NEW JERSEY, 1980,
Geological Survey, Trenton, NJ. Water Resources Div.
T. V. Fusillo, and L. M. Voronin.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $9.00, Microfiche $4.50. Geological Survey Open-File Report 81-814, May, 1981. 38 p, 1 Fig, 2 Plates, 6 Tab, 19 Ref.

Descriptors: *Water quality, *Groundwater, *Data collections, Unconsolidated aquifers, Aquifer characteristics, Sampling, Chemical analysis, Wells, Well data, Inorganic compounds, Organic compounds, *Water analysis, Coastal plains, *New Jersey, Potomax-Raritan-Magothy aquifer system, Pennsylvania.

Samples for chemical analysis were collected from June to December 1980 from 262 wells tapping the Potomac-Raritan-Magothy aquifer system. The samples were analyzed for common ions, dissolved metals, nutrients, dissolved organic carbon, volatile organic compounds, pH, temperature, and specific conductance. This report contains the results of the analyses, well construction data for the wells sampled, and simple statistical summaries for each parameter. Most parameters showed wide variations in concentration. Concentrations of dissolved organic carbon ranged from 0 to 108 mg/L (milligrams per liter), with a median of 1.7 mg/L. Chloride concentration ranged from 0.8 to 810 mg/L, with a median of 15 mg/L. Iron concentration ranged from 3 micrograms per liter to 79,000 micrograms per liter, with a median of 1,400 micrograms per liter. Detectable concentrations of volatile organic compounds were found in 46 wells, approximately 19 percent of the 246 wells sampled for such compounds. Trichloroethylene and benzene, the most common compounds, were detected in 24 and 18 wells, respectively. The maximum concentrations of several compounds detected include: benzene, 1,960 micrograms per liter; 1,1-dichloroethylene, 670 micrograms per liter; trichloroethylene, 472 micrograms per liter; and tetrachloroethylene, 335 micrograms per liter. (USGS)
W82-04515

QUALITY OF SURFACE WATER IN THE COAL-MINING AREAS OF WESTERN MARYLAND AND ADJACENT AREAS OF PENNSYLVANIA AND WEST VIRGINIA FROM APRIL 1979 TO JUNE 1980,
Geological Survey, Towson, MD. Water Resources Div.
W. W. Staubitz.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $13.75, Microfiche $3.50. Geological Survey Open-File Report 81-812, August, 1981. 103 p, 1 Fig, 6 Tab, 7 Ref.

Descriptors: *Water quality, *Strip mines, *Streamflow, *Data collections, Monitoring, Networks, Surface water, Sediment discharge, Coal mining, Water analysis, Benthic fauna, Base flow, *Eastern Coal Province, Area 5, Area 6, North Branch Potomac River, Youghiogheny River, Casselman River, Maryland, Pennsylvania, West Virginia.

The U.S. Geological Survey is monitoring the water quality of streams within the Eastern Coal Province. This report contains streamflow, water-quality, and biological data collected in the North Branch Potomac River basin and in the Maryland portion of the Youghiogheny and Casselman River basins. Data collected from 64 streams from April 1979 to June 1980 are presented in tables. Other sources of hydrologic information within the study area are also described in the report. (USGS)
W82-04516

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-4A, H-4B, AND H-4C AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-04517

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142902, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-33, May, 1981. 297 p, 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Water supply, *Irrigation, *Surface water, *Data collections, *Water quality, Water analysis, Trace elements, Hardness, Water use, *Oklahoma, Arkansas River, Verdigris River basin, Neosho River basin, Illinois River basin.

Water-quality data in the Arkansas River mainstem and the Verdigris, Neosho, and Illinois River basins within Oklahoma were examined for water type and suitability for public water supply and irrigation use. The classification of water type was based on the relation of the major ions: calcium, magnesium, sodium, bicarbonate/carbonate, sulfate, and chloride to each other within the range of measured specific conductance. The judgement of suitability for public supply use was based on the concentration levels and distributions of selected constituents. The Wilcox irrigation classification scheme was used to relate sodium concentrations and the salinity distribution to the use of the water for irrigation. The possibility of phytotoxic effects from boron was discussed where data were available. (USGS)
W82-04518

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1980--VOLUME 1. DELAWARE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190372, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-80-1, 1981. 341 p, 8 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, *Delaware River basin.

Water resources data for the 1980 water year for Pennsylvania consist of records of discharge and water quality of streams, elevation and contents of lakes and reservoirs, and water levels of groundwater wells. This volume contains records for water discharge at 73 gaging stations, elevation and contents at 11 lakes and reservoirs, water quality at 39 gaging stations, and water levels at 16 observation wells. Also included are data for 43 crest-stage 28 low-flow, and 43 water-quality partial-record stations. Locations of these sites are shown on figures 4 through 7. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 2 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W82-04521

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1980. APPENDIX - COAL AREAS.
Geological Survey, Charleston, WV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-159674, Price codes: A11 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WV-80-A, October, 1981. 228 p, 9 Fig, 8 Tab.

Descriptors: *Coal, *Hydrologic data, *Surface water, *Water quality, Streamflow, Flow rates, Sediments, Water analysis, Water temperature, Chemical analysis, Coal mines, Data collections, Sites, *West Virginia, Coal areas.

Water resources data for the 1980 water year for coal regions of West Virginia consist of discharge and water-quality records collected during two sampling periods at 369 sites. Also included are sediment data from 26 sites. Data were collected as a part of the statewide Coal Hydrology project. (USGS)
W82-04522

WATER RESOURCES DATA FOR LOUISIANA, WATER YEAR 1981--VOLUME 3. COASTAL LOUISIANA.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-129305, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report LA-81-3, 1981. 218 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Louisiana, *Coastal Louisiana.

Water resources data for the 1981 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 81 gaging stations (including stage for 76 of these stations); stage only for 37 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 142 surface-water stations (including 35 gaging stations), 27 miscellaneous sites, 10 lakes, and 286 wells; and water levels for 679 observation wells. Also included are data for 250 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W82-04523

8. ENGINEERING WORKS

8A. Structures

RIDING MILL PUMPING STATION,
D. J. Banks, D. F. H. Pain, and W. Banks.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 6, p 463-482, 1981. 7 Fig, 6 Ref.

Descriptors: *Water conveyance, *Construction, Design criteria, Maintenance, Pumps, *Water supply systems, Kielder Water Scheme, Pumping plants, River Tyne, River Wear, River Trees, *England, Water transfer, Pipelines, Water demand.

The large pumping capacity, intermittent usage, and large size of the Riding Mill pumping station have demanded reconsideration of usual water supply practices. The operating concepts, design development, and plant selection are described for this plant, which is part of the Kielder Water Scheme and is designed for bulk transfer of water from the River Tyne to the Rivers Wear and Trees. Tyne water is relatively unpolluted, with virtually no suspended solids. Therefore it was possible to use single-stage pumping and thus avoid the major costs of low-lift pumps and large settling tanks. Debris and sediment intake problems was reduced by arranging the draw-off to avoid obstruction to river flow and keeping the draw-off sill above river bed level and the intake velocity as low as possible. Fine mesh band screens were placed in a chamber back from the river frontage to protect the pumps and exclude smolts. Trash bars were selected rather than penstock openings. The pumping station was designed for unattended automatic operation. A special pipeline filling pump was installed. (Baker-FRC)
W82-04292

APPROXIMATE SIZING OF RESERVOIRS FOR DETENTION TIME,
Commonwealth Tech, Inc., Lexington, KY.
J. S. Tapp, A. D. Ward, and B. J. Barfield.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 17-23, January, 1982. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Detention times, *Reservoir design, *Sedimentation basins, Design criteria, *Sediment control, Spillways, Hydrographs, Storms, Rainfall, Reservoir storage.

Design of sediment control reservoirs has been facilitated by a new procedure using triangular hydroraphs to give a first approximation of the peak outflow and storage volume necessary to give a desired detention time. Only 1 or 2 trials are necessary. The size of the spillway system and the sediment pond design may be hand calculated for a given detention time. The triangles approximate the inflow-outflow hydrographs. This method was compared with the detailed computer model DEPOSITS. After modifications in the equations, the standard error was an acceptable 0.028 watershed in. The procedure is applicable to reservoirs with principal spillway crests located at the top of the sediment storage pool. (Cassar-FRC)
W82-04315

MICRO HYDROPOWER IN THE USA,
EG and G Idaho, Inc., Idaho Falls.
R. O. Haroldsen, and F. B. Simpson.
International Water Power and Dam Construction, Vol 33, No 11, p 48-50, November, 1981. 1 Fig.

Descriptors: *Hydroelectric plants, *Powerplants, *Economic evaluation, Water resources development, Rural areas, Diesel units, Case studies.

Micro hydropower is not expected to make a major contribution to the nation's energy production. However, developers may gain a measure of independence and security, especially in isolated areas where small diesel units are used. Two plants are described. The 50 kW plant at Bliss, Idaho, produces $1000 per month of power from a $40,000 capital investment. A low head installation (effective head 2 m) at Aumsville, Oregon, produces a maximum 23 kW out of a design 40 kW. Many other problems make this site a poor investment, producing only $100-200 of power monthly. There is a need for reasonable standards to cover connections with the utility power grid and for better information on site assessment, equipment, institutional requirements, and available technology. (Cassar-FRC)
W82-04316

OBTAINING LAYOUT OF WATER DISTRIBUTION SYSTEMS,
Department of the Air Force, Washington, DC.
W. F. Rowell, and J. W. Barnes.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 137-148, January, 1982. 4 Fig, 17 Ref.

Descriptors: *Network design, Pipes, *Water distribution, Water quality control, *Model studies,

Water demand, Water conveyance, Water mains, Design criteria, *Water supply systems.

A procedure to help with selecting a water distribution network layout involves two steps. The first step uses a nonlinear programming model to select an economical tree layout for the larger diameter pipe links to provide service under normal demand. The second step uses an integer programming model to choose loop-forming redundant links and corresponding link diameters to provide adequate capacity in case the large diameter primary link system fails. The second level system reduces water stagnation, retards sediment accumulation, facilitates pipe cleaning, and provides alternate paths. The procedure is illustrated using a two-source water distribution system. (Cassar-FRC)
W82-04319

SMALL HYDRO SCHEMES FOR PRIVATE DEVELOPERS,
Hydro Watts Inc., Washington Grove, MD.
S. L. Bierman, and R. A. Klempner.
International Water Power and Dam Construction, Vol 33, No 11, p 35-36, November, 1981. 1 Tab.

Descriptors: *Hydroelectric plants, *Powerplants, *Dams, Hydraulic structures, *Cost analysis, Feasibility studies, Costs.

Incentives for private developers to invest small (less than 5 MW) hydropower schemes include rising fuel prices, governmental financial assistance, and the obligation of utilities to offer to buy output. There are 700 existing U.S. dams which are feasible to develop. Average head is 15 m; average flow, 10 cu m per sec; and average reservoir surface area, 2.4 million sq m. Development costs, which range up to $2000 per kW of installed capacity, are quipment, 33% of total costs; civil works. 40-50%; engineering and interest during construction, 10-15%; and contingency, 10%. Operating costs are variable and may be as high as 6 cents per kWh. (Cassar-FRC)
W82-04327

RURAL POWER SCHEMES IN PAKISTAN,
Peshawar Univ. (Pakistan). Dept. of Electrical Engineering.
M. Abdullah, and A. R. Inversin.
International Water Power and Dam Construction, Vol 33, No 11, p 23-25, November, 1981. 2 Fig.

Descriptors: *Rural areas, *Hydroelectric plants, *Pakistan, *Developing countries, Design criteria, Powerplants, Hydraulic structures, Dams.

In the mountainous remote regions of northern Pakistan there are 22 5-15 kW microhydropower schemes in operation. Costs per installed kilowatt are $250-400. These projects are built by villagers from local materials. No engineering drawings are provided. Technical assistance is given by the Appropriate Technology Development Organization, a government agency. A typical installation has an intake consisting of a low stone weir and unlined headrace. Penstocks, usually 5-15 m long, are made of steel pipe or oil drums. The cross-flow turbine is made locally from strips of steel or pieces of pipe. Generators, presently made in China, will be manufactured locally in the near future, saving about 25% in costs. The electricity is generally used for lighting and to run machines in cottage industries. (Cassar-FRC)
W82-04328

PUMPED OUTLETS FOR DRAINAGE SYSTEMS,
A. T. Corey.
Transactions of the ASAE, Vol 24, No 6, p 1504-1507, November/December, 1981. 1 Fig, 3 Ref.

Descriptors: *Drainage systems, *Sumps, *Storage capacity, Design criteria, *Pumps, *Tile drainage, Subsurface drainage, Conduits.

The size and cost of storage capacity of sumps for pumped outlets of subsurface drainage systems can be reduced by using the disposal tile as part of the storage system. This is feasible where the tiles can be below the grade of the collector tiles so that submergence of the main drain does not block discharge from the laterals. The maximm discharge capacity of the disposal tile should be nearly that of the pump, or else the pump motor will cycle excessively when the tile is flowing nearly full. Equations and a method for designing necessary sump storage are given. (Cassar-FRC)
W82-04364

OPTIMAL DESIGN OF URBAN STORM WATER DRAINAGE SYSTEMS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. K. Robinson, and J. W. Labadie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211491, Price codes: A02 in paper copy, A01 in microfiche. In: Proceedings 1981 International Symposium on Urban Hydrology, Hydraulics, and Sdiment Control, July 27-30, 1981. University of Kentucky, Lexington. 12 p, 4 Fig, 6 Tab, 12 Ref. OWRT C-90037-U(0507)(1). 14-34-0001-0507.

Descriptors: *Urban drainage, *Storm sewers, Minimum cost, Storm sewer design, Dynamic programming, *Design criteria, *Costs, Systems analysis, Comparison studies.

Several researchers have developed screening models for minimizing the cost of sizing and vertical alignment of storm sewer systems. One of the disadvantages of these models is that they are designed with specific physical/economic assumptions in mind, as well as specific types of cost functions. These assumptions are effectively hardwird into the program, which militates against modifying the program to suit situations not covered in the original assumptions. A generalized dynamic programming computer code has been developed at Colorado State University called CSUDP. A library of subroutines is being prepared as an adjunct to the basic code for solving a wide range of civil engineering problems. One of the packages includes a set of subroutines for storm sewer design. The coding includes data management routines for convenience to the user not familiar with dynamic programming. The code can consider complex branching networks with up to three pipes entering a given manhole. Default options are available for excavation, pipe, and manhole cost functions. If the costs for a particular case have a significantly different structure, the user can supply his own subroutine. There are several other default options which make this program extremely convenient for normal design conditions, as well as usable for unique problems. Extensive comparisons have been made between available published results of other dynamic programming screening models and the CSUDP package. Results are extremely close. The one comparison resulting in a large deviation was due to slightly differing hydraulic and cost assumptions, which caused larger commercial pipe sizes to be chosen by CSUDP, even though actual pipe requirements deviated little.
W82-04414

JET INJECTIONS FOR OPTIMUM MIXING IN PIPE FLOW,
Turner, Collie and Braden, Inc., Houston, TX.
S. D. Fitzgerald, and E. R. Holley.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1179-1195, October, 1981. 5 Fig, 11 Ref. OWRT A-091-ILL.

Descriptors: *Pipe flow, *Jets, *Mixing, Optimization, Pipes, Uniform flow, Water currents, Pipelines.

The use of jet injections was evaluated to provide initial mixing and thereby hasten the mixing process between a miscible substance and water flowing in a piepline. The study experimentally investigated several jet injection systems to determine their mixing characteristics, identified those systems providing the most rapid mixing, determined optimum operating conditions, and investigated the effects which secondary currents had on the mixing. For uniform pipe flow with a given number and orientation of jets, the ratio of jet momentum flux to the pipe-flow momentum flux was the parameter indicative of the mixing induced by the jets. Under many circumstances, it may be practical to consider only a 90 deg angle of injection. Experiments also investigated two diametrically opposed 90 deg jets in uniform flow. Optimum mixing was obtained when the momentum ratio for each jet was on the order of one-half of the optimum momentum ratio for a single jet injection. Also, experiments on a pipe flow with an induced secondary current indicated that the use of two or more jets would provide a factor of safety against the effects of unknown secondary currents. (Small-FRC)
W82-04558

DETERMINATION AND REPRESENTATION OF THE STORAGE EFFECT (ZUR ERMITTLUNG UND DARSTELLUNG DER SPEICHERWIRKUNG),
Technische Univ., Dresden (German D.R.).
For primary bibliographic entry see Field 4A.
W82-04576

METHODS FOR ASSESSMENT OF STREAM-RELATED HAZARDS TO HIGHWAYS AND BRIDGES,
Colorado State Univ., Fort Collins. Engineering Research Center.
H. W. Shen, S. A. Schumm, J. D. Nelson, D. O. Doehring, and M. M. Skimmer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-219750, Price codes: A12 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-80/160, March, 1981. 252 p, 32 Fig, 3 Tab, 51 Ref, 4 Append. DOT-FH-11-9396.

Descriptors: *Bridge design, *Highways, *Hydraulic design, *Stream erosion, *Bank erosion, Sedimentation, Deposition, Bridge failure, Land use, Remote sensing, Slope stability, Stream banks, Avulsion, Aggradation, Meanders, Morphology, Scour, Waves, Flotsam.

River behavior at a highway crossing depends not only on the stability of that particular river reach, but also on the behavior of the entire fluvial system. A complete evaluation of hydraulic hazards cannot be solely based on on-site hydrologic, hydraulic and geomorphic factors; but must also include insight into historic trends, synoptic considerations of basin characteristics, and anticipation of future changes. Because determination of stream-related hazards is a complex task, it is beneficial to generalize relative stability based on stream type. Streams can be divided into five types based on channel pattern and mode of sediment deposition. Each stream type exhibits its own characteristic stability. After evaluating stream variables, a list of potential stream hazards can be developed. Stream-related hazards include: degradation and scour; nickpoint migration; bank erosion; aggradation and fill; downfilling and backfilling; berming; meander growth and shift; channel bars and islands; cutoffs; avulsion; river-metamorphosis; floating objects; waves and surges. Each potential hazard can be evaluated on an individual basis and properly considered in either the design of a new crossing or maintenance of an existing one. Numerous evaluation methods are available to hydraulic engineers that have not been fully utilized. Methods such as remote sensing, land use evaluation and slope stability analysis should not be overlooked. (Moore-SRC)
W82-04626

THE DESIGN OF ENCROACHMENTS ON FLOOD PLAINS USING RISK ANALYSIS,
Federal Highway Administration, Washington, DC. Office of Engineering.
M. L. Corry, J. S. Jones, and P. L. Thompson.
Hydraulic Engineering Circular No 17, October, 1980. 134 p, 15 Fig, 14 Tab, 23 Ref, 3 Append.

Descriptors: *Flood plains, *Bridge design, *Risks, *Highways, *Flood damage, *Cost analysis, Culverts, Scour, Channel erosion, Economic aspects,

Design criteria, Embankments, Dikes, Earthworks, Alternative planning.

The design of all flood plain encroachments should include an evaluation of the inherent flood related risks to the highway facility and to the surrounding property. When this evaluation indicates that the risk warrants additional study, a detailed analysis of alternative designs is necessary in order to determine that design with the least total expected cost (LTEC) to the public. An essential ingredient in the LTEC design concept is risk analysis. All quantifiable losses are included in the risk analysis. These may involve damage to structures, embankments, surrounding property, traffic related losses and scour or stream channel damage. The product of the risk analysis is the annual economic risk associated with each design strategy. The sum of the annual economic risk and the annual capital costs results in the total expected cost (TEC) for each design strategy. Comparison of the TEC's for all design strategies allows the designer to select the LTEC or optimum design. Although the emphasis in this manual is on bridge crossings, the LTEC decisionmaking process concept is applicable to other drainage features. For example, it may be utilized in the design evaluation of culverts, longitudinal encroachments, countermeasures and foundation elevations. (Moore-SRC)
W82-04631

APPLICATION OF THE SOUTHWELL PLOT METHOD TO THE INSPECTION AND TESTING OF BURIED FLEXIBLE PIPES,
Cambridge Univ. (England).
A. J. Valsangkar, A. M. Britto, and M. J. Gunn.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 63-82, March, 1981. 14 Fig, 5 Tab.

Descriptors: *Pipes, *Buckling, *Deformation, Nondestructive tests, Southwell plot, *Stress, Flexibility, Inspection, Safety, Soil mechanics, Soil strength, Pipelines, *Design criteria.

A nondestructive method for estimating the buckling load of buried flexible pipes uses the Southwell plot. It allows estimation of a generalized out-of-roundness and predicts a buckling load. The difference between predicted and actual buckling loads is greater at larger initial out-of-roundness values for the buried pipe. A method is presented for estimating the safe failure load from the Southwell plot buckling load and the generalized out-of-roundness. Experimental data produced by other investigators on the stability of buried pipes were used to test the validity of this method. Very flexible pipes (effective stiffness < 0.5 kN per sq m) in dense sand produce small deflections before failure and cannot be reliably analyzed by the Southwell plot method. Pipes with effective stiffness of 3.62-157.1 kN per sq m may be loaded to about two thirds of their buckling load, at which stage the Southwell plot is linear. (Cassar-FRC)
W82-04649

ADOPTING SEWERS,
Southern Water Authority (England).
J. Budleigh.
Water, No 42, p 20-21, 1982. 2 Ref.

Descriptors: *Sewer systems, *Design criteria, Management, *Construction, *Housing, Land development.

Traditionally sewers are constructed by the developers of housing projects and offered to the water authority for adoption when finished in much the same way as estate roads. The ground rules for adoption are laid down in Section 17 and 18 of the Public Health Act of 1936. Two alternative arrangements are offered to the developer. In Section 17 he may design and construct the sewers as he sees fit and then offer them for adoption. Section 18 provides for a clear cut agreement prior to construction between the developer and the sewerage authority. A considerable step forward would be provided for by a national agreement on the standards and conditions which must be met by the water and housebuilding industries. Such an agreement has been reached. As far as the design and layout of sewers is concerned, the standards required are generally in line with the present British Standard Code of Practice for sewerage, CP2005. One long standing problem has been the supervision allowed by Section 18 on the part of the sewerage authority. The building company generally does not object to the fact that supervisors from the sewerage authority are present, but does object to having to pay for this. Another problem concerns the provision of a guarantee to the authority that the builder would actually carry on and finish the sewers as agreed. The third problem has to do with sewage pumping stations. These problems are dealt with in the housing developer's guide. (Baker-FRC)
W82-04655

JAMES BAY SPILLWAYS AND CONTROL STRUCTURES,
La Societe d'Energie de la Baie James, Montreal (Quebec).
K. R. Ludwig, and R. T. Olive.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 183-198, December, 1981. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Spillways, *Flow control, *Hydraulic gates, James Bay, *La Grande Complex, *Quebec, Hydraulic structures, *Reservoirs, Water resources development, Gates, Hydraulic design, Flow velocity, Design criteria, Concrete, Maintenance, Cold weather construction, Bridges, Ice, Dam construction, Hydroelectric plants.

The structural conception of the major spillways and control structures of Quebec's six-reservoir La Grande Complex is summarized. All spillways and control structures contain a gate structure and a downstream discharge facility. Concrete has been used only where necessary to control flow, since the resistance of rock in this region is superior to concrete. The standardized gate opening is 40 ft, and all gates are of the flat, wheeled, vertical-lift type. The number of gates varies with the discharge capacities. Flow velocities have been limited to 60 ft per sec at the sill and 100 ft per sec at the downstream end for structures in intermittent operation. Control structures in use for prolonged periods are limited to a maximum velocity of 60 ft per sec for no more than 10% of the time. Drainage systems are located in areas protected against freezing, and gates are equipped with electric deicers. The dam bridge, aligned with the crest to either side of the spillway, is upstream of the stoplogs. Discharge from the gate structures is handled in a variety of ways, depending on the location. These include stilling basins, rock cut channels to the lake or river, chutes, flip buckets, intervening lakes, plunge pools, and combinations of these. (Cassar-FRC)
W82-04692

DETERMINING FEASIBILITY OF SMALL-SCALE HYDROPOWER,
Tudor Engineering Co., San Francisco, CA.
For primary bibliographic entry see Field 6B.
W82-04693

TAPERED INLET DESIGN USING SPECIFIC ENERGY CURVES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
R. L. Rossmiller, and M. D. Dougal.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 127-135, January, 1982. 4 Fig, 5 Ref.

Descriptors: *Design criteria, *Culverts, *Inlets, Hydraulic structures, Water conveyance, Conduits, Pipes, Highways, Iowa, Specific energy curves, Economic aspects.

Design charts for the hydraulic design of tapered inlet highway culverts are given for both rectangular (box) and circular (pipe) sections. Errors, design time, and construction costs are greatly reduced by use of these charts. In Iowa savings from the use of tapered culverts at individual sites range from $1000 to over $100,000, for a total of millions of dollars over the past few years. The raised inlet culverts can form ponds for recreation or stock watering and help stabilize the upstream channel slope. For box culverts the chart plots depth in feet against specific energy head in feet for different ratios of design discharge to width of culvert. For pipe culverts, depth to pipe diameter ratio is plotted against specific energy to diameter ratio for different values of Q squared divided by D to the 5th power, where Q = design discharge and D = diameter of pipe. (Cassar-FRC)
W82-04695

YEAR-ROUND DISTRIBUTION SYSTEM MAINTENANCE,
Connecticut Water Co., Clinton.
For primary bibliographic entry see Field 5F.
W82-04699

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION, DESIGN ASPECTS AND ALTERNATIVES,
Whitman and Howard, Inc., Wellesley, MA.
For primary bibliographic entry see Field 5G.
W82-04701

THE ROOFLOAT (FLOATING) COVER SYSTEM FOR LIQUID STORAGE,
Globe Linings Inc., Long Beach, CA.
For primary bibliographic entry see Field 5G.
W82-04702

8B. Hydraulics

ASYMPTOTIC SOLUTION FOR DAM-BREAK PROBLEM,
Cantebury Univ., Christchurch (New Zealand).
B. Hunt.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 115-126, January, 1982. 6 Fig, 9 Ref.

Descriptors: *Dam failure, *Kinematic wave theory, *Flood waves, Wave propagation, Hydraulics, Reservoir releases, Water flow.

The kinematic wave approximation is used to obtain a simple, closed-form solution for the catastrophic failure of a dam upon a dry, sloping channel. The solution validity is investigated by computing orders of magnitude for neglected terms in the equations of motion and by comparing the solution with the results of previously calculated numerical solutions and with experimentap results. These calculations and comparisons suggest that the kinematic wave solution becomes asymptotically valid after the flood wave has advanced about four reservoirlengths downstream. (Author abstract)
W82-04313

MEASUREMENT OF AIR IN FLOWING WATER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7B.
W82-04322

USE OF TWIN WELLS AND WATER-SOURCE HEAT PUMPS FOR ENERGY CONSERVATION IN LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
R. Kazmann.
Technical Report No 9, December 181. 68 p, 27 Fig, 22 Tab, 16 Ref, 2 Append.

Descriptors: *Wells, *Pump wells, *Injection wells, Recharge wells, Site selection, Water cooling, Well water, Heated water, Thermal pollution, Aquifers, Cooling, Air temperature, Water table decline, Conservation, *Louisiana, *Energy conservation, Heat pumps.

Acceptance of water-source heat pumps has been slow because of potential environmental impacts

(water-level declines, subsidence, injecting substances into aquifers), cost, and lack of design data. The purpose of this work was to determine proper well spacing for single sets of twin wells, and for multiple sets; to examine the feasibility of their use in two Louisiana parishes; and to determine the potential use, economics, and environmental impact of water-source heat pumps. The use of twin wells--one to pump water, one to recharge the aquifer--precludes groundwater declines and, if properly spaced, avoids altering the groundwater temperature. The well used for production in summer is used for injection in winter, and vice-versa. A table is given to approximate the needed spacing between the wells. Even using an annual interest rate of 14%, a water-source heat pump and single well combination is often the most effective system for heating/cooling. In many areas of the two parishes studied, this system will be economical, especially in areas underlain by groundwater at shallow depth. Also, if properly designed and built, twin well systems will have no environmental impact on the biosphere and only minimal thermal impact on the source aquifers. It is recommended that no legislation be adopted that would prevent use of the system for those wanting to conserve energy; that research be encouraged to achieve higher coefficients of performance by use of a new working fluid, an increase in the throughput of water, or by reducing head loss in a unit; and that a streamline-tracking program be prepared to compute the consequences of operating large numbers of well pairs. (Atkins-Omniplan)
W82-04387

JET INJECTIONS FOR OPTIMUM MIXING IN PIPE FLOW,
Turner, Collie and Braden, Inc., Houston, TX.
For primary bibliographic entry see Field 8A.
W82-04558

STORM SEWER FLOW COMPUTATIONS,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W82-04640

THE VORTEX SCOUR MECHANISM AT BRIDGE PIERS,
Zakir Husain Coll. of Engineering and Technology, Aligarh (India).
A. Qadar.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 739-757, September, 1981. 13 Fig, 8 Tab, 10 Ref.

Descriptors: *Scour, *Vortices, *Erosion, Sediment transport, *Piers, Rivers, Hydraulics, Riprap, Bridges, Flow around objects, Flow characteristics, *Bridge piers.

A tilting non-recirculating flume (0.3 m wide x 0.45 m deep x 5 m long) was used to study the vortex scour mechanism at bridge piers. First, experiments were performed on a rigid bed to study the behavior of the scouring vortex. Second, a sand bed was installed to measure the depth of scour holes. Results of field tests at several bridges in India and Canada were also reported. Several conclusions were developed from the observations. The basic mechanism of localized scours was identified as a secondary circulation caused by an upstream flow separation ahead of the pier. The maximum depth of the scour is a function of the strength of the vortex which develops ahead of the pier and is described in an equation containing the following terms: initial strength of vortex, an experimentally determined exponent to sediments up to 0.5 mm in diameter. For larger-sized sediments, roughness elements cause a reduction in scour. Although the depth of the approach flow has little measurable effect on maximum scour depth, there is a minimum depth of flow necessary for full development of vortex action. Scouring may be prevented or reduced by installing large-size riprap around piers or by weakening the basic mechanisms. (Cassar-FRC)
W82-04642

FLOW RESONANCE IN RIGID PIPES WITH REGULAR LONGITUDINAL CORRUGATIONS,
Thessaloniki Univ., Salonika (Greece). Dept. of Hydraulics.
P. Latinopoulos, and D. K. Tolikas.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 263-267, March, 1981. 3 Ref.

Descriptors: *Pipe flow, *Resonance, *Flow characteristics, Wave propagation, Hydraulics, Water hammer.

The method of multiple scales was used to derive a uniform first order expansion for the condition of resonance in a corrugated pipe. Weak waves caused by small undulations on the pipe wall can be generated. Under certain conditions a resonance occurs that is independent of water hammer or resonance due to reflections at the boundaries of the system. Resonance can be expected when the wave number of the wall undulations matches the difference of the wave number of any two propagating nodes which are strongly coupled and travel unattenuated along the pipe. (Cassar-FRC)
W82-04644

ANALYSIS OF THE HYDRAULIC JUMP WITHIN A DIVERGING RECTANGULAR CHANNEL,
University of Wales Inst. of Science and Technology, Cardiff.
P. W. France.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 369-378, June, 1981. 6 Fig, 8 Ref.

Descriptors: *Hydraulic jump, *Spillways, Dam design, *Channel flow, Flow characteristics, Froude number, Model studies.

Properties of hydraulic jumps with parallel-sided channels and gradually diverging rectangular channels were compared theoretically and in laboratory flume studies. An equation was developed to predict the sequent depth in a diverging channel. The relative energy loss in a diverging channel was 12% higher than in a parallel-sided channel for the same Froude number. Although the energy loss was independent of the angle of divergence, it was a function of the sequent radius ratio. The lengths of diverging jumps were about 40% less than the straight-sided jumps for the same Froude number. The sensitivity of the jump became more stable as the angle of divergence increased. (Cassar-FRC)
W82-04645

SIMULATION OF SURGES AFTER REMOVAL OF A SEPARATING BARRIER BETWEEN SHALLOWER AND DEEPER BODIES OF WATER,
University of Strathclyde, Glasgow (Scotland).
D. I. H. Barr, and M. M. Das.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 911-919, September, 1981. 9 Fig, 7 Ref.

Descriptors: *Surges, *Barriers, *Flow characteristics, Hydraulics, Water level, Channel flow, Roughness, Water depth, Simulation analysis.

Surges produced after removal of a barrier separating water bodies with surfaces at different levels were numerically simulated. The equations were based on the St. Venant equations as applied to the dry bed dam burst case. Laboratory measurements were taken in rectangular channels with both smooth and artificially roughened surfaces. Laboratory data were compared with numerical simulations on three bases: surface profiles, depth hydrographs, and front trajectories. Agreement between observed and calculated values was good. Increased rates of damping and lagging of the surge front were seen both in the smaller-scale experiments and in roughened channels. (Cassar-FRC)
W82-04685

RESISTANCE EQUATION FOR LARGE-SCALE ROUGHNESS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W82-04696

8C. Hydraulic Machinery

RIDING MILL PUMPING STATION,
For primary bibliographic entry see Field 8A.
W82-04292

VERTICAL ROUND BUOYANT JET IN SHALLOW WATER,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-04365

AERATION CHARACTERISTICS OF FLOW RELEASE CONTROLS ON ILLINOIS WATERWAY DAMS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 5G.
W82-04388

JAMES BAY SPILLWAYS AND CONTROL STRUCTURES,
La Societe d'Energie de la Baie James, Montreal (Quebec).
For primary bibliographic entry see Field 8A.
W82-04692

8D. Soil Mechanics

DESIGN OF FILTERS FOR CLAY CORES OF DAMS,
Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 8G.
W82-04321

INCIPIENT MOTION OF SAND PARTICLES ON SIDE SLOPES,
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
S. Ikeda.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 95-114, January, 1982. 15 Fig, 2 Tab, 22 Ref.

Descriptors: *Slope stability, *Tractive forces, *Sediment transport, Channel erosion, *Stream banks, Sand, Erosion, Sedimentation, Flow velocity, Critical velocity, Turbulent flow, Drag, Soil mechanics, Hydraulics, Channel scour.

Although several criteria have been theoretically proposed for the critical shear stress of noncohesive sediment on side slopes of river and channel banks, no laboratory work on this problem has been reported. This paper presents a theoretical study on the incipient motion of sediment particles on side slopes, accounting for the effects o the viscous sublayer, turbulence, and lift force. A laterally tilting wind tunnel was used to measure critical shear stress on side slopes from 0 to 40 degrees. Wind velocity varied from 0 to 30 m per sec. Two grades of noncohesive sand with median diameters of 1.3 and 0.42 mm were used in the experiment. Results of the wind tunnel tests confirmed the theory presented in this paper. On level beds the incipient motion of sand particles was essentially stochastic for the 1.3 mm sand, with a few particles first set in motion in isolated spots. The 0.42 mm sand particles moved intermittently as a unit. Although the lift force can be neglected when using the most probable values of critical tractive forces, it should be included for safety. The present equation does not account for disturbances such as sand waves, channel irregularities, and bends. (Cassar-FRC)
W82-04368

WET DISPOSAL OF FOSSIL PLANT WASTE: CASE HISTORY,

Ebasco Services Inc., Norcross, GA.
For primary bibliographic entry see Field 5E.
W82-04385

WATER MOVEMENT FACTORS IMPORTANT TO THE DESIGN AND OPERATION OF SUBIRRIGATION SYSTEMS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W82-04538

EVALUATION OF A CHIMNEY DRAIN DESIGN IN AN EARTHFILL DAM,
Geological Survey, Doraville, GA.
M. L. Maslia, and M. M. Aral.
Ground Water, Vol 20, No 1, p 22-31, 1982. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Mathematical models, *Earth dams, *Drainage systems, *Performance evaluation, Soil physical properties, Clays, Sand filters, Silt, Model studies, Mathematical studies, Numerical analysis, Pressure head, Seepage, *Wallace Dam, Georgia.

The finite element Galerkin method was used to formulate a numerical model to study the performance of a vertical drainage filter in a clay fill zone of the Wallace Dam on the Oconee River, Georgia. The resulting model was applied to determine the steady-state saturated-unsaturated seepage characteristics at Station 58 + 00 on the west dike of the earthfill dam. Numerical results for the four cases (clay fill, sand filter, silty sand, and weathered) analyzed define the location of the zero pressure isobar and total hydraulic head values ranging from 130 m to 11 m. Using a saturated horizontal hydraulic conductivity of 8.64 cm/day, a maximum seepage velocity of 0.80 m/day was calculated, resulting in a maximum seepage rate of .752 cu cm/sec. An average pressure head reduction of 16 m from the upstream to the downstream side of the dam was determined from hydrostatic uplift forces along the base of the dam. When local seepage velocities were compared to critical seepage velocities inside of an upstream of the filter, safety factors against piping ranging from 0.3 to 3.7 were found. (Geiger-FRC)
W82-04675

8G. Materials

THE SIDERITE MODEL OF THE FORMATION OF CORROSION-RESISTANT SCALES,
Karlsruhe University (Federal Republic of Germany), Water Chemistry Dept.
For primary bibliographic entry see Field 5F.
W82-04270

DESIGN OF FILTERS FOR CLAY CORES OF DAMS,
Imperial Coll. of Science and Technology, London (England).
P. R. Vaughn, and H. F. Soares.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT1, p 17-31, January, 1982. 8 Fig, 18 Ref.

Descriptors: *Filters, *Dam design, *Cores, Sand filters, Soil filters, Clays, Dam failure, Soil mechanics, Grading, Permeability, Sediment sorting, Erosion, Cracks, *Balderhead Dam, *England.

The failure of a filter drain in the clay core of Balderhead Dam, Northern England, prompted a study of filter effectiveness and design. Although the grading of the crushed limestone filter material conformed to accepted designs, the possibility of cracks in the clay core had not been considered. In the Balderhead Dam erosion damage developed above a crack in the clay core. The damage zone contained lenses and other signs of segregation by water action. In some sections of the crack coarse particles accumulated, allowing small soil particles to be lost and enlarging the crack. A 'perfect' filter was designed for the Cow Green Dam and the Empsingham Dam to retain the smallest particles (in this case clay flocs) that can arise during erosion. Laboratory tests helped determine that natural, unwashed sand was suitable as the fine filter. An experimental relationship was found between the size of the particle retained by the filter and its permeability. In the laboratory uniformly-sized filter materials produced fail-no results. Graded filters showed a range during which slow clogging occurred. Permeability appears to be a better method of describing the retention characteristics of a filter than grading. (Cassar-FRC)
W82-04321

COVERING BOTTOM SEDIMENTS AS A LAKE RESTORATION TECHNIQUE,
Kent State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W82-04421

8I. Fisheries Engineering

ENGINEERING IN CATFISH PRODUCTION,
P. Forsythe.
Agricultural Engineering, Vol 61, No 6, p 18-21, June, 1980.

Descriptors: *Fisheries, *Catfish, *Catfish farming, Catfish ponds, Fish harvest, Water pollution sources, Fish farming, Food processing wastes.

Scientifically managed catfish pond systems are used to produce an average yield of 3000 lb/acre. Optimum pond efficiency results from a layout of 8 ponds per 160 acre area each 660 ft by 1320 ft. The ponds are confined by levees having a 14 ft top width and 3:1 side slopes providing 2 ft of freeboard. The water area is about 17 acres. Th drainage of ponds at harvest creates significant shock loads to streams. The unused catfish feed plus wastes provides an enriched discharge. When fish are processed, processing wastes are treated usually in oxidation lagoons and discharged into city treatment systems. The handling and disposal of processing wastes needs the most attention from agricultural engineers. There is a tremendous opportunity to utilize these thousands of tons of fish protein. The effects on water quality of pond draining also need further investigation. (Small-FRC)
W82-04367

STATUS REPORT ON STRIPED BASS ANALYSES,
California State Dept. of Fish and Game, Sacramento.
Staff report prepared for the State Water Resources Control Board, Sacramento, California, January 20, 1982. 47 p 21 Fig, 10 Tab.

Descriptors: *Fish populations, *Bass, *Fish food organisms, *Fish diets, Fish eggs, Regression analysis, Correlation analysis, Diversion, Fish foods, Food chains, Phytoplankton, Zooplankton, Distribution patterns, Powerplants, Striped bass, *California.

In 1976, the California Department of Fish and Game (DFG) submitted evidence to the State Water Resources Control board indicating that the abundance of young striped bass was largely controlled by the magnitude of Delat outflow and losses in water diversions by the Central Valley Project and the State Water Project. When the abundance of bass was lower than DFG's expectations, the evidence was reexamined. Four hypotheses were advanced--increased competition, diversion, food abundance, and outflow. Most testing used correlation or multiple regression analyses, but a limiting factor of these approaches was that they only determined whether variables vary in a similar manner. None of the hypotheses described the actual mechanisms controlling striped bass abundance since 1959. Other hypotheses are being tested. However, a common theme was the variations in Delta outflow in spring/early summer have a major effect on abundance. High flows spread striped bass over a larger area and expansion of habitat reduces intraspecific competition and, thus, survival. High flows also probably increase food supply for young bass. Several regression analyses indicate that stock size, not food supply, may have caused the unusually low abundance of striped bass since 1976, but that hypothesis, too, has been questioned because bass are so prolific and because of evidence of stock size limitation elsewhere. A basic problem is that striped bass populations have been increasing recently, so any variable with a declining trend is correlated with young bass abundance whether a cause and effect relationship exists or not. (Atkins-Omniplan)
W82-04386

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

SEARCH: A GAGED WATERSHED INVENTORY,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
P. E. Black.
Water Resources Bulletin, Vol 16, No 5, p 894-899, October, 1980. 4 Fig.

Descriptors: *Information retrieval, *Watersheds, Computers, Surveys, Information systems, Hydrologic data collections, Data collections, Data storage and retrieval, *New York, *Streamflow, *Gaging stations.

The purpose of this paper is to provide the potential user of SEARCH with the information needed to implement its use. The purpose of the program is to provide a ready inventory and search of all gaged streams in New York along with a compilation of major parameters upon which a decision to use records from such a gage might be based. The method is adaptable to any other state or region. The method as described is adapted to an APL interactive terminal, allowing the operator to thoroughly search a large set of gaged watersheds to find sources of comparable hydrologic data for detailed analysis. Bases of the search include drainage basin size and elevation and geographical and temporal parameters. (Baker-FRC)
W82-04433

TNRIS: A SOURCE FOR WATER-RELATED DATA IN TEXAS.
Southwest and Texas Water Works Journal, Vol 63, No 4, p 10-11, July, 1981. 1 Fig, 2 Tab.

Descriptors: *Data storage and retrieval, Information systems, Weather, Water quality, Water supply, Wells, Precipitation, *Texas, TNRIS.

The Texas Natural Resources Information System (TNRIS) stores, processes, and disseminates data and information on Texas' water and other natural resources to State agencies, other governmental agencies, universities, and the public. The system provides access to hydrological, meteorological, geological, biological, socioeconomic, and base data located in more than 300 automated files and over 150 manual files. Base data includes maps and remotely sensed data. TNRIS data files cover such areas as daily and monthly precipitation, daily pan evaporation, daily surface water conductance, surface water quality, daily suspended sediment, and water well measurements. Data for these files are supplied by the National Weather Service, the U.S. Geological Survey, the International Boundary and Water Commission, and Texas State agencies. In addition, TNRIS interfaces with data bases maintained by the U.S. Geological Survey, the Environmental Protection Agency, the Department of Commerce, the Department of Agriculture, and the Department of Energy. TNRIS is capable of providing computer-printed reports, graphic outputs, interface with remote terminals, statistical packages, computer-generated microform, geocoding, analysis of remotely sensed data, catalogs and indices, information on availability of specialized data, and ordering services. The System also conducts a variety of remote sensing and cartographic activities. TNRIS can be assessed

by letter, telephone, terminal, or personal visit. (Carroll-FRC)
W82-04651

AN INTERACTIVE DATA MANAGEMENT SYSTEM FOR RIVER WATER QUALITY DATA,
Michigan Univ., Ann Arbor. School of Public Health.
R. A Deininger.
Water Research, Vol 16, No 1, p 31-36, January, 1982. 2 Fig, 13 Tab, 3 Ref.

Descriptors: *Water quality, *Data storage and retrieval, *Information systems, Computers, Rivers, Statistical analysis, *Ohio River basin.

A water quality data bank for interactive use is described. Unlike the STORET, NAQUADAT, and EIS systems in the U.S., Canada, and Scandinavia, respectively, this system allows the user to search, update, retrieve, and analyze data from a computer terminal without the help of specially trained personnel. This system, located at the University of Michigan, can be accessed by local telephone numbers in 100 U.S. and Canadian cities and by the TELENET system from European cities. The system is illustrated by a sample problem using a small water quality data base with values for 9 selected parameters from 35 monitoring stations in the Ohio River Basin. Statistical analysis can be performed using the MIDAS software system. Graphs may be displayed on a television screen. (Cassar-FRC)
W82-04659

10C. Secondary Publication And Distribution

ANNOTATED SELECTED REFERENCES ON NATURAL RESOURCES INVESTIGATIONS, COLLIER COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. J. Swayze.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $6.00, Microfiche $3.50. Geological Survey Open-File Report 81-1184, 1981. 45 p.

Descriptors: *Bibliographics, *Publications, *Natural resources, Hydrology, Geology, Ecology, Geochemistry, *Florida, *Collier County, Biology.

A data base for future natural resources investigations in Collier County, Fla., was initiated by compiling a selected annotated bibliography. This report provides references and annotations for selected reports released between 1950 and 1978. The references are presented by subject material as follows: biologic, ecologic, geologic, geochemical, and hydrologic. (USGS)
W82-04508

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